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65th MORSS

Final Program & Book of Abstracts

Marine Corps Combat Development Command
Quantico, Virginia
10 - 12 June 1997

Theme:
Analysis for Complex, Uncertain Times

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SPECIAL SESSION I
TUESDAY - 1530 – 1700 – 10 JUNE

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CAPT Lee Dick, Space & Naval Warfare Command
Sue Iwanski, Northrop Grumman Corporation
Edward Smyth, JHU/APL
Anne Patenaude, SAIC

Tuesday, 1530 - 1700.. **Ellis Hall**

Analysis for Complex, Uncertain Times: Applying the Non-Linear Science of Chaos and Complexity

*Coordinator: CAPT **Lee Dick**, SPAWAR*

Panelists include: ***LtGen Van Riper**, USMC*
*Mr. **Jeff Cooper**, SAIC*
*COL **Chris Arney**, USMA*
*CDR **Dennis McBride**, NRL*

This panel will present and discuss the science of complexity theory. The panel will explore the demonstrable applications of complexity research and complexity theory which can be availed to today's analyst.

With the notion that many processes such as international politics, ecology, market economics, societal behavior and battlefields, while unpredictable according to stochastic theory, are within bounds and self-organizing. These processes encapsulate everything between those which are linear and those which are purely random. In fact, those which are on the extreme, linear or random are few in number. Moreover, traditional operational analysis has focused on the few, the explainable, with little progress on the vast majority of the phenomena in between.

As the interest in complexity has gained momentum, it has necessarily brought with it a vocabulary all of its own. Terms which are already becoming familiar in the scientific world include artificial life, biocomplexity, cellular automata, chaos, criticality, fitness landscapes, flocking, fractals, learning systems, neural networks, non-linear dynamics, parallel computation, patches, percolation, self-organization, simulated annealing and tau theory to name a few. The presentations will touch on a few of these as the panel examines the relevance of the study of complex systems to the world in which we live.

What has enabled this new science, the catalyst so to speak, is technology and innovation. Without the advances in computational processing, the ability to peel back the onion to locate simple deterministic rules in complex systems would not be possible. Thus information technology is at the very heart of complexity theory.

Physicist Heinz Pagel stated, "I am convinced that the nations and people who master the new sciences of complexity will become the economic, cultural and political superpowers of the next century." Shall we take this a step further and state that, as military analysts, those who understand and apply these techniques will dominate the battlefields of the 21st century? Perhaps so.

Tuesday, 1530 - 1700.. **MCRC Auditorium**

A Mini-Symposium Report: Quick Reaction Analysis Methodology (QRAM)

Coordinator: Dr. Jacqueline Henningsen, OD PA&E, OSD

In October 1996, MORS held a mini-symposium called "Quick Response Analysis Requirements and Methodologies (QRAM)." QRAM was organized in response to Sponsor's interest in exploring first order analysis methodologies in preparation for the Congressionally mandated Quadrennial Defense Review (QDR). This Special Session

will look at the current QDR and the challenges for QDR analysis in the future. QRAM leaders will be introduced and will frame questions for the speakers at the end of the session.

Featured Speakers:
Mr. ***Bill Lynn****, Director of Program Analysis and Evaluation, OSD*
"The Quadrennial Defense Review"
Mr. ***Paul Davis****, RAND (QRAM Synthesis Group Chair)*
"Looking Beyond the QDR: Analytic Insights and Challenges"

Tuesday, 1530 - 1700.. **SNCOA - 1**

Meet the Editors

Dr. **Gregory S. Parnell**, Virginia Commonwealth University; Editor, *Military Operations Research*
Dr. **Julian I. Palmore**, University of Illinois; Editor, *PHALANX*

This Special Session is your chance to discuss the scope and direction of your publications with the senior decision makers. Anyone with a general interest in these publications, or individuals interested in publishing in *PHALANX* or *MOR* cannot afford to miss this session. We look forward to seeing you there.

Julian Palmore intends to discuss several practical items of interest to *PHALANX* contributors. These include (1) deadlines to be observed, (2) guidelines for submissions, (3) the *PHALANX* audience, (4) importance of the lead article, (5) *PHALANX* departments, and (6) the role of the printer in last minute sizing decisions about how to structure an issue.

Greg Parnell will discuss several journal topics of interest to Military Operations Research contributors. These include: editorial policy, guidelines for submission, the MOR audience, the paper review process, and statistics on acceptance rates.

Tuesday, 1530 - 1700.. **SNCOA - 2**

Rist and Barch Prize Paper Session

Prize Paper Coordinator: *James B. Duff, PRC, Inc.,*
Rist Prize Coordinator: *Howard Whitley, USA CAA*
Barchi Prize Coordinator: *Dr. Roy Rice, Teledyne Brown Eng*

The **Rist** and **Barchi Prizes** will be announced and awarded in the opening ceremonies of the 65th MORSS. This special session will provide the opportunity for the prize winners to present their winning papers. The Committee Chairs will discuss the prize process and pertinent points from select non-winning papers.

Barchi Prize Paper
Explaining the Coalition Loss Rate in the Gulf War

Stephen Biddle
Institute for Defense Analyses
1801 N Beauregard St
Alexandria VA 22311
Phone: 703-845-2272
FAX: 703-845-2255
e-mail: sbiddle@ida.org

The standard explanations of the Gulf War's military outcome are wrong. New data and counterfactual analysis using computer simulation techniques undermine both the orthodox view (that new technology was chiefly responsible for the war's one-sidedness) and its main rival (which emphasizes Iraqi shortcomings, not US strengths). Instead, the paper proposes a new explanation based on the nonlinear interaction of new weapons, Iraqi mistakes, and US skill. That is, new US technology served mainly to *punish Iraqi errors* with unprecedented severity. Sizeable Iraqi forces survived the air campaign and attempted to resist the Coalition ground offensive. These defenders made manifold mistakes, but so have

many other armies. Against older weaponry, such mistakes have been harmful but not nearly so catastrophic as in 1991. Against 1991 technology, however, such errors enabled new weapons to operate with proving-ground effectiveness, providing unprecedented lethality. Without the Iraquis' errors, however, the same US technology could not have prevented radically higher US losses. The paper provides policy implications for force planning, budgeting, and theater campaign assessment, and concludes by arguing that the common view of the Gulf War as heralding a "revolution in military affairs" is based on a fundamental misreading of the war's actual military dynamics.

Rist Prize Paper
Optimization Modeling for Airlift Mobility

David P. Morton, Graduate Program in Operations Research, University of Texas
Richard E. Rosenthal, Operations Research, Naval Postgraduate School
Capt **Lim Teo Weng,** Republic of Singapore Air Force

In a Operation Desert Storm type scenario, massive amounts of equipment and large numbers of personnel must be transported over long distances in a short time. The magnitude of such a deployment imposes great strains on air, land and sea mobility systems.

The US military services are well aware of this problem and various optimization and simulation models have been developed to help improve the effectiveness of limited lift assets and alleviate the problem. Congress commissioned the Mobility Requirement Study (MRS) in 1991, when post-operation analysis of Desert Storm revealed a shortfall in lift capability.

Two linear programming (LP) optimization models that were developed as part of MRS and subsequent studies form the primary background of this research. They are: (1) the Mobility Optimization Model (MOM) developed for MRS by the Joint Staff's Force Structure Resource, and Assessment Directorate (J8) [Wing *et al.*, 1991] and (2) the THRUPUT Model developed by the USAF Studies and Analyses Agency (USAF/SAA) [Yost, 1994]. MOM considers both air and sea mobility, whereas THRUPUT and the model developed here cover only the air aspects of the problem. The model of this paper was first described in a Naval Postgraduate School master's thesis [Lim, 1994], which was sponsored by USAF/SAA.

In this research, the strategic airlift assets optimization problem is formulated as a multi-period, multi-commodity network-based linear programming model, with a large number of side constraints. It is implemented in the General Algebraic Modeling System (GAMS) [Brooke et al., 1992], and its purpose is to minimize late deliveries subject to physical and policy constraints, such as aircraft utilization limits and airfield handling capacities. For a given fleet and a given network, the model can help provide insight for answering many mobility questions, such as: 1) Are the aircraft and airfield assets adequate for the deployment scenario? 2) What are the impacts of shortfalls in airlift capability? 3) Where are the system bottlenecks and when will they become noticeable? This type of analysis can be used to help answer questions about selecting airlift assets and about investing or divesting in airfield infrastructure.

SPECIAL SESSION 2
WEDNESDAY - 1030 - 1200 - 11 JUNE

Wednesday, 1030 - 1200 .... **Ellis Hall**

Crisis Response Panel
Coordinator: **Ted Smyth**, JHU/APL

Panelists include:
RADM **Robert Nutwell**, SPAWAR
BrigGen **Matt Broderick**, USMC
Mr. **James Q. Roberts**, OSD(SO/LIC)
Col **Pete Peterson**, USAF Checkmate Office
Col **Gabe Rouquie**, Jr, USA, HQ USCENTCOM

Many believe that the types of crises and conflicts that we have experienced since the end of the cold war will likely continue into the early decades of the twenty-first century. During this period, the nation's military services, along with civil agencies and other nations, may be called upon to defend and promote national and

collective security interests throughout the world, often on short notice and often in combinations of nations and armed forces not previously experienced.

This special session panel will address the military response to such crises and conflicts that for the purpose of discussion are defined as ranging from a military attack against our nation or interests, to acts of political violence against Americans abroad, to "operations other than war" such as disaster relief or evacuation of American citizens. In particular, panel members will be asked to offer comment on the projected nature and frequency of crisis response operations and the role and use of analytical and decision support tools in the crisis response decision making process.

Wednesday, 1030 - 1200

Junior/Senior Analyst Session

Coordinators: ***Robert Orlov***, *The Joint Staff,* ***Howard Whitley***, *US Army CAA and CDR* ***Dennis Baer***, *NCCA*

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RADM Pierce J. Johnson, Naval Reserve Readiness Command Region SIX
Brian R. McEnany, SAIC

Wednesday, 1030 - 1200 .... **MCRC Auditorium**

A Mini-Symposium Report: Complexity in Models and Simulation

Chairs: *Dr.* ***Marion Williams****, FS, AFOTEC* and ***Jim Sikora****, FS, BDM*

The use of M&S of military systems has dramatically increased because of the decreasing DoD budgets and the rapidly advancing computer and software technology. There has been an explosion of new M&S projects to take advantage of this new, more efficient technology and to create cheaper to use, more capable tools to use for military applications. The advancing M&S technology areas include methodologies and techniques for linking different models together as well as for use in conjunction with other warfare analysis tools. The ability to technically link various models has increased significantly, but now we must also determine how to "logically link to achieve analytically sound results." There are issues concerning the ability to link or integrate models for any particular application. These issues involve the linking of models of different levels and types as well as the use of common M&S elements and standards. This commonality is particularly important because of increasing M&S requirements and decreasing budgets to satisfy those requirements.

The objectives of the mini-symposium were to: (a) review current and future M&S linkage activities and projects with a focus on the impact on analysis applications and analysis capabilities, (b) increase the military applications community's understanding of M&S linkage issues, problems and potential solutions, and (c) provide interface/interactions among the members of the military applications community in the area of M&S linkage.

The MORS session will summarize the findings of the mini-symposium along with recommendations for future actions.

Special Session 3
Thursday - 1030 – 1200 - 12 June

Thursday, 1030 - 1200 .... **Ellis Hall**

Congressional Appreciation of Military OR Panel

Coordinator: ***Anne Patenaude****, SAIC*

This panel is being constituted with the help of the Army office of Congressional Liaison. Panel intent will be to have Congressional staffers give their views in a discussion on how military analysis affects issues on the Hill and the areas in which it is most useful.

Thursday, 1030 - 1200 .... **SNCOA - 1**

Education Session

Coordinator: *Dr.* ***Yupo Chan****, AFIT/ENS*

In the 12th Education Colloquium held in April, the Education Committee formalized a plan for further improving tutorial offerings. Instead of the one-hour format at the annual Symposium, tutorials will be more frequent and more substantive. As an experiment, two half-day tutorials will be offered in the 65th Symposium at Quantico, one on the day before the meeting, and another during the Symposium. They are on the timely topics of " High Level Architecture" and " Implementation of Verification, Validation and Accreditation." We would like to have your inputs regarding how to make these tutorials as responsive to your needs as possible. Other topics covered in the Colloquium include the current status of Military Operations Research graduate education and future cooperation with the Institute for Operations Research and Management Science. We would also like your suggestions on what other activities the committee should look into in the future.

Thursday, 1030 - 1200 .... **SNCOA - 2**

Urban Terrain Warfare—A Modeling Challenge for the 21st Century

Colonel ***Raymond R. Cole***, USMC
Chief, Land & Littoral Warfighting Assessment Division, J-8

Our World view has been shaped throughout history by demographics—even geography is only an enabler or impediment to the whims of human habitats and environs. The competition for these regions and the resources contained therein form the framework for inevitable human conflict.

The science of demography offers us a glimpse into the next century, and it is not entirely a world of our

choosing. Both population explosion and migration in the third world will see large cities, traditionally located in the littorals, expand to form an unbroken expanse of urban terrain.

Popular literature, from futurists like the Tofflers to the Joint Strategic Review see trends leading to a world of increasing chaos and conflict. As military planners, we must continually evaluate our toolbox to see if we are propagating the appropriate doctrine, equipment, models and training for this future.

To date, that evaluation remains elusive. Urban terrain is difficult to model, not only because of its complexity, but because it does not fit the Major Theater of War constructs developed for a bi-polar world.

The challenge, then, is to develop the techniques and models to enable the warfighter of the future to know what tools to bring to the warfight. The challenge allows today's developers of future requirements to more accurately assess the capabilities required in a future world. Urban modelers need to match their parametric skills with the statistical skills of the demographer if they are to remain relevant into the 21st Century.

Thursday, 1030 - 1200 .... **MCRC Auditorium**

A Workshop Report: Analytic Tools and Methods for Operations Other Than War (OOTW)

Chair: *Dr. **Cy Staniec**, Logicon*

Just as the pace of Operations Other Than War missions has continued to escalate, so has the need for tools to support planning and analysis of these missions. This workshop undertook the task to develop a recommended "way ahead" to acquire the analytic methods and tools necessary to support OOTW. The workshop participants included DoD, other government, non-governmental organizations, as well as international participants. This Special Session will provide an overview of the findings and recommendations of the participants, as well as a chance to ask questions of the Working Group chairs.

TUTORIALS

TUESDAY, WEDNESDAY, THURSDAY - 1215 – 1315

Tutorial Coordinators:

LTC Patrick Vye, Joint Staff

Dean Hartley, Data Systems R&D Program

Phil Kubler, USA TRAC

Tuesday, 1215 - 1315 .... **C&SC - 216**

Practical Approaches to VV&A (Part I)

Mr. **Pete Knepell**, Logicon

The Verification, Validation & Accreditation (VV&A) of models and simulations (M&S) is a topic of high interest in the defense community. DOD and service directives emphasize the need to build reliable and credible models and simulations. While the motivation for VV&A is clear, the directives do not prescribe methods or procedures - and for good reason: M&S sponsors, developers and users face different problems involving intended use, risk, model detail/complexity/size, and the availability of real-world data.

This three-part tutorial will focus on the "How To" of VV&A. The first session will present a methodology that was successfully applied to nearly 20 simulation tools that varied greatly in size, complexity and application. The second part covers the application of experimental design to VV&A with special consideration of M&S used to support Test & Evaluation. The third session addresses the VV&A of legacy models with an emphasis on tools and techniques to improve efficiency. All sessions have examples of applications.

The tutorial is aimed at model managers, developers, evaluators and users faced with the challenges of VV&A. Prior experience with statistics is not needed to understand the session on experimental design. Participants should leave with good ideas on how to approach their VV&A journeys and a few tools to help them along the way.

Part I: VV&A: A Confidence Assessment Methodology; Motivation For The Methodology; Strategies For Success; 7 Habits Of Highly Successful M&S Organizations

Tuesday, 1215 - 1315........ **SNCOA - 1**

Using DTIC for Research and Publishing

Mr. **Frank Scott**, Defense Technical Information Center (DTIC)

Learn how the Defense Technical Information Center (DTIC) provides value added bibliographic information to your analytic products and makes them available only to the DoD audience you specify. Learn how to search and download either unclassified/unlimited bibliographic information or full text studies from DTIC's Scientific and Technical Information Network (STINET) via the world wide web. And, hear how DTIC is using publishing technology to convert both your paper and electronic studies into Internet accessible documents either on your web site of DTIC's.

Tuesday, 1215 - 1315........ **Ellis Hall**

Deterministic vs. Stochastic Models

Dr. **Dean S. Hartley III**, Oak Ridge National Laboratory

Deterministic models yield an answer. Deterministic models are simpler than the corresponding stochastic models. Deterministic models are simpler to explain to the end-user than are stochastic models. Deterministic models are incorrect (being approximations), but so are stochastic models. Why, then, would one prefer a stochastic model?

This tutorial addresses the nature of deterministic and stochastic models. It presents a simple example that illustrates the types of considerations involved in choosing one over the other. No prior knowledge is required (assuming only that common among MORS members). This tutorial is especially appropriate for those involved in modeling anything containing irrevocable events - such as death.

If you have been confused about stochastic models, this is for you. This tutorial is especially appropriate for managers and decision makers. (Those who are intensely involved in stochastic models already will only be interested to the extent that the tutorial helps them explain things to their users.)

Tuesday, 1215 - 1315........ **SNCOA - 2**

Advanced Methods in Simulation Analysis

Tom W. Lucas and **Louis Moore**, RAND

Simulation models play a critical role in many decisions. Too often the size and complexity of the models, as well as setup and run times, result in insufficient model runs to make definitive conclusions; much less sufficient sensitivity analysis. We can improve the efficiency and effectiveness of our studies by modern methods of simulation analysis, such as, bootstrapping, variance reduction techniques, advanced design of experiments, and exploratory modeling.

This course is designed for practitioners of simulation, though, targeted at those who do not use the above advanced techniques. Very little time will be devoted to simulation background and implementation issues. The goal is to introduce modelers to some advanced simulation techniques, identify situations were they might be especially useful, and provide pointers so interested persons can get the details necessary to apply the methods. The emphasis will be on stochastic simulations. Don't be the last person on your project to use a bootstrap. Make covariance your friend through variance reduction techniques. Pick your samples optimally through design of experiments. Better understand and communicate your analysis through exploratory modeling.

Wednesday, 1215 - 1315........ **C&SC - 216**

Practical Approaches to VV&A (Part II)

Mr. **Pete Knepell** and Mr. **Tom Curry**, Logicon

The Verification, Validation & Accreditation (VV&A) of models and simulations (M&S) is a topic of high interest in the defense community. DOD and service directives emphasize the need to build reliable and credible models and simulations. While the motivation for VV&A is clear, the directives do not prescribe methods or procedures - and for good reason: M&S sponsors, developers and users face different problems involving intended use, risk, model

detail/complexity/size, and the availability of real-world data.

This is the second part of a three-part tutorial that focuses on the "How To" of VV&A. This second part covers the application of experimental design to VV&A with special consideration of M&S used to support Test & Evaluation.

The tutorial is aimed at model managers, developers, evaluators and users faced with the challenges of VV&A. Prior experience with statistics is not needed to understand the session on experimental design. Participants should leave with good ideas on how to approach their VV&A journeys and a few tools to help them along the way.

Part II: The Synergy Of Experimental Design And VV&A
- Overview Of Experimental Design
- Applications And Benefits In VV&A
- Application With Test & Evaluation

Wednesday, 1215 - 1315.. **Ellis Hall**

Information Systems Security

Mr. **Tony Stramella**, Information Systems Security Organization

Information systems security and intelligence have always complemented each other. Information systems security prevents others from gaining a comparable advantage over us. Intelligence gives us an information advantage over our adversaries and competitors. The two functions serve as the offensive and defensive squads of a team dedicated to a single goal—information superiority for America.

Information systems security and intelligence are becoming more than complementary—they are integral to each other. This integration is driven by the threat that has emerged as the down side of the information age—the threat of information warfare.

NSA's Information Systems Security Organization (ISSO) mission is to provide solutions for a nation at risk. Our requirements are growing rapidly in scale and complexity. The U.S. is highly dependent on networked information systems and our U.S. infrastructure is currently at risk. Our customers include traditional national security customers, the military, as well as an expanding set of commercial customers whose vital national services are critical to U.S. readiness and national preparedness. The ISSO has the authority to protect U.S. classified information and information systems. The ISSO also works in partnership with the National Institute of Standards and Technology (NIST) to ensure that sensitive but unclassified information and information networks are adequately protected.

This tutorial is about who we are, what we do, why we do it, and what are we doing about it.

Wednesday, 1215 - 1315.. **SNCOA - 1**

Value-Focused Thinking: Developing the Value Model Hierarchy

Dr. **Gregory S. Parnell**, FS, Virginia Commonwealth University, Department of Mathematical Sciences

The key idea in Value-Focused Thinking (VFT) is that we should start any decision analysis by examining the values of the decision-makers and, if appropriate, the stakeholders. The value model is used to qualitatively and quantitatively capture the decision-makers' values. The most challenging step in the process is the development of the qualitative value model, the value model hierarchy of evaluation considerations. Once we have developed our value model hierarchy, we can use the mathematical techniques of multiattribute utility theory to complete the quantitative value model.

After a brief summary of Value-Focused Thinking, we focus on developing the value model hierarchy. We summarize the alternative approaches that are described in the literature: Top Down Objectives-Driven and Bottom Up Alternatives Driven. We identify the pros and cons of these two approaches. Next, we describe two new approaches: Gold Standard and Bottom Up Verb-Driven. We illustrate how we have successfully used each approach. We conclude by identifying the key questions to ask to help select the best approach develop the value model hierarchy.

Wednesday, 1215 - 1315.. **SNCOA - 2**

Stochastic Optimization via the Simultaneous Perturbation Algorithm

James C. Spall, The Johns Hopkins University, Applied Physics Laboratory

Multivariate optimization algorithms play a major role in virtually all areas of engineering. This tutorial is an introduction to the Simultaneous Perturbation Stochastic Approximation (SPSA) algorithm for multivariate optimization. SPSA has attracted considerable international attention in areas such as statistical parameter estimation, pattern recognition, neural network and fuzzy logic training, adaptive feedback and process control, and experimental design. The essential features of SPSA are its great efficiency in multivariate problems and its relative ease of implementation for practitioners. This tutorial will discuss the benefits and limitations of the algorithm and will illustrate its application in several distinct areas. The class of problems for which the algorithm is most appropriate is one where it is difficult and/or impossible to obtain the gradient of the objective function with respect to the terms being optimized. The tutorial is aimed at practitioners and others who face difficult optimization problems in their work; extensive prior experience with optimization is not required to understand the tutorial material. It is expected that upon completion of the tutorial, participants will be able to quickly employ the algorithm in their own optimization problems.

Thursday, 1215 - 1315.. **C&SC - 216**

Practical Approaches to VV&A (Part III)

Mr. **John Magerko** and Mr. **Bill Skeith**, Logicon

The Verification, Validation & Accreditation (VV&A) of models and simulations (M&S) is a topic of high interest in the defense community. DOD and service directives emphasize the need to build reliable and credible models and simulations. While the motivation for VV&A is clear, the directives do not prescribe methods or procedures - and for good reason: M&S sponsors, developers and users face different problems involving intended use, risk, model detail/complexity/size, and the availability of real-world data.

This is the third part of a three-part tutorial that focuses on the "How To" of VV&A. This third session addresses the VV&A of legacy models with an emphasis on tools and techniques to improve efficiency. Included are examples of applications.

The tutorial is aimed at model managers, developers, evaluators and users faced with the challenges of VV&A. Prior experience with statistics is not needed to understand the session on experimental design. Participants should leave with good ideas on how to approach their VV&A journeys and a few tools to help them along the way.

Part III: VV&A Of Good Ole Legacy Models
- Sizing Up The Problem
- Prioritizing And Scaling Efforts
- Tools And Techniques

Thursday, 1215 - 1315.. **SNCOA - 1**

Quantification of Requirements to Meet JROC Approval Using a METOC Case Example

Richard A. Hess, Science Advisor, Joint Staff - J8

The JROC - Joint Requirements Oversight Council is the voice of the warfighter in the DoD acquisition process. The JROC, through the Joint Warfighting Capability Assessment (JWCA) process, is the mechanism for determining priority requirements of Key Performance Parameters (KPPs) in Major Defense Acquisition Programs (MDAP).

Using DoD Meteorology and Oceanography (METOC) programs the tutorial will address quantification of METOC data, its importance to the warfighter, and examples of the impact of METOC on joint warfare (i.e., ASW, SOF, MIW, etc.). Examples of ongoing and proposed METOC programs (i.e., sensor/satellite systems) providing support to the warfighter will be discussed.

The JCS (warfighter) perspective, with regards to Joint Vision 2010, the Joint Warfighting S&T Plan, PPBP

(Planning Programs & Budget Process), and issues that drive the need to quantify the impact of METOC programs on the warfighter will be examined.

The challenge - the Warfighter, METOC, and Operations Research communities must collaborate on the assessment of the impact of present and planned METOC programs.

(703)693-5332 FAX: (703)697-6610

Thursday, 1215 - 1315.. **SNCOA - 2**

Toward Practical Mathematical Methods for Conducting Model Validation and Design

Dr. **John D. Morrison** and Dr. **Michael McKay**, Los Alamos National Laboratory

Mathematical models are used to provide decision makers with predictions about real world events. However, in order to make properly informed decisions about the decision- and cost-risks associated with alternative model designs, decision makers need model developers to answer three questions:

- To what extent does this composition preserve what is known and what is not known about that domain? Or,
  --how much precision was lost to aggregation, and
  --was the underlying uncertainty in the data preserved?
- What modifications to the model would produce the most significant impact on the accuracy of its predictions?
- Are there simpler model designs that have equivalent levels of prediction accuracy?

When applying the model to an analysis requirement, analysts must answer two questions to help decision makers manage their decision risk:

- What would be the influence of alternative initial conditions and system characteristics on this prediction?
- How much uncertainty is there in these model predictions, and where does it come from?

This tutorial will report on recent research and case studies that were focused on how to apply formal (yet practical) statistical methods to provide "quantitative" answers to the questions posed above. Model evaluation methods to be presented are intended to be a starting point for answering questions such as: How might strong and weak characteristics of alternative models and sub-models be identified? Are there ways to intelligently select among different modeling techniques for different parts of the modeling process? Are there formal analysis methods for ranking alternative models? How can the current family of models be improved and effectively linked? Where might research dollars be spent to advantage in improving data used for model inputs as well as supporting field trials?

Thursday, 1215 - 1315.. **Ellis Hall**

Decision Analysis and Systems Analysis

LTC **Patrick Vye**, The Joint Staff, J6

Decision analysis and decision theory have been around for many years. Many people are familiar with decision trees or influence diagrams and their use. However, people rarely give careful consideration to the systems analysis process that goes into the formulation of a decision tree-- which may be the hardest part of the problem.

This tutorial will discuss the systems analysis process by which the components of a decision tree are developed. This begins by eliciting the objectives, values and criteria via value-focused thinking. Alternatives are generated and then sensitivity analysis is used to screen the alternatives and deal with uncertainty. Bayesian updating can be used when additional information is elicited. Finally results are presented as a multicriteria decision problem.

This tutorial is aimed at individuals who are unfamiliar with decision analysis, those who are familiar but would like to learn more about how to structure the problem, and finally those who would like to learn additional techniques that can be used in conjunction with decision analysis.

COMPOSITE GROUP I -- STRATEGIC
WORKING GROUPS 1, 3, & 4
CHAIR: DR. ROBERT BATCHER, ACDA
WEDNESDAY, 1330 – 1500 .... MCRC AUDITORIUM

Future Strategic Force Structures: Implications for Deterrence and Warfighting

Scott E. Goehring, Major, USAF, **Kenneth L. Hagerup**, and **Lynn Langer**
US Strategic Command, J53
Offutt AFB, NE 68113-5000
402-294-4526; FAX 402-294-6148

This paper presents the findings of a wargame examining the implications of a variety of possible future strategic nuclear force structures. The wargame employed the Arsenal Exchange Model (AEM) and the Fallout Assessment — System/Civilian Vulnerability Indicator Code (FAS/CIVIC) models to provide data for analysis. Areas addressed included; warheads executed under a variety of attack options; arriving warheads; available and strategic reserve warheads remaining after execution and attrition due to an adversary's attack; and quantitative consequences of execution. The wargame also examined numerous non-quantitative issues involving deterrence, stability, and strategic nuclear warfighting. Finally, the wargame presented the advantages and disadvantages of each of the three possible strategic Dyads, should the United States decide to remove one of the three legs of the present strategic nuclear Triad.

The Counterproliferation Analysis & Planning System (CAPS)

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Approved abstract not available at printing.

COMPOSITE GROUP II -- NAVAL WARFARE
WORKING GROUPS 5 & 6
CHAIR: CDR KIRK MICHEALSON, USN, OSD PA&E
TUESDAY, 1030 – 1200 .... ELLIS HALL

Navy Response to the Quadrennial Defense Review

RADM John W. Craine, Jr., USN
Director, Assessment Division (N81)
Chief of Naval Operations
2000 Navy Pentagon
Washington, DC 20350-2000
703-697-0831; FAX 693-9760

Congress legislated the Quadrennial Defense Review (QDR) in the Fiscal Year 1997 Authorization Bill. The law mandates an internal review by the Department of Defense (DoD) and the Services, plus an independent, external review by

a non-partisan panel of experts (the National Defense Panel). The QDR established panels on modernization, force structure, readiness, strategy, infrastructure, and human resources.

This discussion opens with an examination of the general QDR framework. The focus then shifts to how OPNAV organized to support the QDR and how Navy responded to panel taskings to provide analytical data. Having good, responsive analytical tools in place and the ability to respond with solid analytical data were key elements in making Navy's case. Wargaming and analysis played important roles in Navy's response to addressing the challenges of affordable modernization, readiness, and force structure. Earlier development and refinement of high quality analytical tools let data drive QDR decisions, not vice versa.

Briefing: Mission Area Analysis

Col Richard J. Linhart, Jr.
Director, MCCDC, Studies and Analysis
3300 Russel Rd
Quantico, VA 22134-5130

This brief will discuss the new Mission Area Analysis (MAA) process recently instituted by the Marine Corps. The function of the MAA process is to identify capabilities and deficiencies in key functional areas. The MAA output is used in the development of Marine Corps requirements in our Combat Development Process. In the past, the MAA process was highly subjective and lacking in analytical rigor. The old methodology consisted of a literature search, data collection through Fleet Marine Force surveys/interviews, task validation/capabilities analysis, and an assessment conference. Oversight for the MAA process was recently reassigned to the Studies & Analysis Division, MCCDC, and is being overhauled to incorporate a much more analytically sound methodology. The new process will begin with the definition of missions and threats through 5 to 8 representative scenarios, employment of Marine forces using our official Marine Corps Concepts and Doctrine, and the usage of wargames, combat models, spreadsheet analysis, and other operations analysis tools, as well as subject matter expert forums, to define our required capabilities and deficiencies. With the new process, the Marine Corps will have an improved basis on which to measure system effectiveness, conduct trade-off analyses between competing systems, compare the effectiveness of competing systems across a wide range of scenarios, and assess various levels of risk.

COMPOSITE GROUP III – AIRLAND CONTINGENCY OPERATIONS

WORKING GROUPS 7, 8, 9, 10, 11 & 14

CHAIR: JOHN R. STATZ, BOOZ, ALLEN AND HAMILTON, INC.

WEDNESDAY, 0830 – 1000 .... ELLIS HALL

JWARS Prototype Status and Demonstration

LTC **Terry W. Prosser**
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The department of defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context

has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a modern object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and will shortly begin development of a production version of the Joint Warfare System.

This abstract proposes a prototype status briefing during the Composite Group 3 session, followed by a demonstration in an adjacent room/facility. The JWARS Office is completing a rapid proof-of-concept prototype period. The briefing will discuss the prototype's role in JWARS development; prototype objectives and status; capabilities represented in the prototype; its relationship to JM&SRG requirements and legacy models; and analytic tools contained in the prototype that could aid, if carried forward to completion, in DoD analysts' productivity. The demonstration will include a full run of the prototype scenario and a discussion and a review of selected analytic tools.

JWARS Prototype Demonstration

WED, 0830 – 1700 .... SAFETY CENTER BLDG
THUR, 0830 – 1400 .... SAFETY CENTER BLDG

COMPOSITE GROUP IV — SPACE/C3I

WORKING GROUPS 15, 16, 17 & 18

CHAIR: WILLIAM G. KEMPLE, NAVAL POSTGRADUATE SCHOOL

TUESDAY, 1330 – 1500 .... ELLIS HALL

Analysis Requirements for Military Operations Other Than War (MOOTW)

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RADM **Robert M. Nutwell**, USN, SPAWAR 06/OPNAV N60, Panel Chair
Lynda Jaques, USPACOM, Panel Member, MOOTW
Stuart Starr, MITRE, Panel Member, C4ISR
Peter Chu, NPS, Panel Member, Military Environmental Factors
TBD, Panel Member, Operational Contributions of Space Systems
TBD, Panel Member, Operations Research and Intelligence Analysis

In the post cold war world, the probability that the next deployment of US military forces will be for a MOOTW is higher than ever before. Our doctrine and analysis tools were developed with combat operations in mind. To what extent do these analysis tools meet today's requirements? What are the gaps, and what tools are needed to fill them? This panel will feature a short presentation by each of the panel members, followed by questions and discussion.

PATTON OR DANTZIG OR BOTH?
FCS Systems Integration with Traditional OR Tools

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Army Vision 2010 calls for the Army After Next "to fight dispersed with extraordinary ferocity and synchronization" in part by capitalizing on emerging technologies. In addition to incorporating significant improvements in the traditional tank and automotive fields the Army's future ground combat vehicles will exploit improved sensor, signature management, communications and information systems. Frequently early design trades seem to be based on the volume of the proponents' voices which results in false starts and considerable stress among team members. A common, mutually agreed upon basic systems integration tool is needed. We present TRADES, the Tactical vehicle Requirement Analysis and Decision Evaluation System.

TRADES exploits established mathematical programming techniques and other traditional Operations Research tools to facilitate management and user insight to the design process and to promote improved communications between parties addressing the systems integration challenge. Using our preliminary IRAD work on the Future Combat System (FCS) as an example, we review the process of:

- describing candidate subsystems and components for potential inclusion,
- developing binding and non-binding (goal) constraints to reflect combat effectiveness, sustainability, deployability, and program management requirements, and
- generating objective functions to address critical design issues (e.g. AOA, trade sensitivities).

We include a brief discussion of how we have used TRADES to support our decision makers in the FCS and other ground combat vehicle programs (e.g. FSCV and FIFV), and close with some ideas on evolving TRADES to accommodate greater granularity and detail in both the subsystems and the requirements as the ground combat vehicle programs mature.

Simulation Test and Evaluation Process (STEP) Guidelines

Mr. **Dennis Hines**
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Under Secretary of Defense for Acq Technology, The Honorable Paul G. Kaminiski, in an address on October 3, 1995, announced he was "required that the Simulation , Test and Evaluation Process - let's call it STEP-shall be an integral part of our Test and Evaluation Master Plans." In addition, he said "this means our underlying approach will be to model first, simulate, then test, and then the test results back into the model."

This presentation will review the motivation for and value of an effective integration of simulation and test in the system acquisition process, and it will describe the process developed by OSD and provided in official guidelines for incorporating STEP.

STEP takes operational and system requirements as inputs, and produces information as output. This information provides the decision maker a scene of how well the system is meeting the operational and system requirements, and how well the risks are being managed. Central to the process is evaluation, both for live testing and simulation. Analysis is essential prior to testing to determine what is to be evaluated, during testing to support those activities, and following the testing to extract the information from those activities.

COMPOSITE GROUP VI -- RESOURCES AND READINESS

WORKING GROUPS 12, 24, 25, 26, 27, 28 & 29
CHAIR: DR. PATRICK D. ALLEN, CUBIC APPLICATIONS, INC.
WEDNESDAY, 1330 – 1500 .... ELLIS HALL

Resource Issues and Readiness Measures: QDR Assessments and Beyond

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In at least two respects, the readiness assessments in the QDR were intellectual and cultural breakthroughs. First, they looked at readiness as time-dependent, supply-and-demand problem. They focused on when units and other assets would need to be ready versus when they could be ready, given their peacetime posture. Second, they looked at the balance of demands from Major Theater Wars versus demand from a host of peacetime operations. In particular, these assessments included development of a stochastic representation of readiness demand for peacetime operations that may provide a useful tool for future readiness and force structure assessments.

Despite this progress, readiness assessments can still be improved, particularly in the quantitative expression of demand for ready forces. In the case of readiness demand for Major Theater Wars, CINC warplans that emerge from the deliberate planning process were used, but arguably should not be the sole basis for assessments in long-range defense planning processes like the QDR. In the case of readiness demand for peacetime operations, the QDR offered some useful methodologies for generating such demand, but often lacked historical quantitative data to use as an empirical calibration for the projections of future demand.

Aside from analytical methods for measuring readiness, the QDR identified a need to revamp the system DoD uses to assess and project the current readiness of our forces. The QDR produced a consensus on the basic concepts for an improved readiness assessment system, and a process leading to its creation and implementation.

COMPOSITE GROUP VII — METHODOLOGIES & TECHNOLOGIES
WORKING GROUPS 30, 31, 32 & 33
CHAIR: DAVID W. HUTCHISON, OCSA-PAED
THURSDAY, 0830 – 1000 .... ELLIS HALL

The Long-term Implications for Analysis of the Quadrennial Defense Review

COL Greg H. Parlier, USA
Program Analysis and Evaluation Directorate
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Phone: DSN 295-4160/2714, COM 703-695-4160/2714

Panel Discussion: The process of developing and resourcing the Armed Forces is a complex and involved procedure. Force structure reviews, such as the Bottom Up Review (BUR), the Commission on Roles and Missions (CORM), and finally the Quadrennial Review (QDR), are relatively new elements in the force development process. While the BUR and CORM were point-in-time reviews, the QDR is a *periodic* force review that may have a dynamic impact on the analytical methodologies employed and on the process as a whole. The continuing, cyclic nature of the QDR requires planners to look at alternative futures and consider how 'today' decisions might affect those futures. The need to consider clear methodologies that can evaluate force alternatives which are adaptive to changing or ill-defined end states is apparent. This implies explicit consideration of uncertainty, and not just risk.

Following a brief presentation on adaptive strategic planning by COL Greg H. Parlier, OCSA PAED, the Composite Group VII Panel of analysts will discuss potential changes to the force development process that may accompany cyclic force reviews of this nature. The panel will discuss the tools necessary to provide critical information to the decision maker, and the impact on the analytical community of developing such tools.

COMPOSITE GROUP VIII -- GENERAL INTEREST
CHAIR: DR. JACQUELINE HENNINGSEN, OSD (PA&E)
THURSDAY, 1330 – 1500 .... ELLIS HALL

Analysis in Support of the Quadrennial Defense Review

Coordinator: Dr. ***Jacqueline Henningsen****, Office of the Director PA&E, OSD*

In summer of 1996, Congress, following the initiative of the Commission on Roles and Missions of the Armed Forces, tasked the Department of Defense to prepare a Quadrennial Defense Review (QDR) at the beginning of each Presidential administration. This session presents a cross-section of some of the analytic work done in the Department in support of the QDR over the last six months. (See the 65th MORSS QDR summary page for other presentations on this topic.)

Invited Speakers:

Mr. **John Osterholz**, Deputy Director of CISA, OSD
"The Challenges of Analyzing the C4ISR Trade Space for the QDR"
Mr. **Royce Kneece**, Office of the Director PA&E, OSD
"Analysis of a Generic Regional Great Power Scenario"
Dr. **Robin Buckelew**, Director, Missile Defense Battle Integration Center,
"Army QDR Analysis"
COL **Rusty O'Brien**, HQ USAF/XO-DAG
"Air Force QDR Analysis"
CAPTAIN **T.J. Gregory**, USN, The Joint Staff/J-8
"The Baseline Engagement Force Study"

Poster Session

The Clubs (Officer's Club)

Tuesday – MIXER - 1715 - 1900 - 10 June

Wednesday - 1200 – 1330 – 11 June

Poster Session Coordinators:
Gene Visco, FS, Consultant
Eleanor Schroeder, DMSO
Doug Schultz, IDA

The 65th MORSS Poster Session is designed to facilitate presentations, demonstrations, and displays—graphical, computer assisted, or combined—by selected personnel from all components of the military services, civilian and military, and their supporting consultants or contractors.

The Poster Session is based on several key objectives. 1) To increase the opportunity for attendees to view projects, demonstrations, and results of studies. 2) To provide an alternate vehicle (in addition to WG sessions) for presenters to display, discuss and present their projects or results.

Conceptual Model of Peace Operations (CMPO)

Poster Session and OOTW Demonstration Session
Presenter: Mr. **Martin Bradeck**, Institute of Public Policy, George Mason University (GMU)

A demonstration of the Conceptual Model of Peace Operations (CMPO) developed by GMU's Program on Peacekeeping Policy will be provided during the Poster and OOTW Demonstration Sessions. CMPO is a computer model that uses a systems engineering and behavior modeling tool, to specify the relationships, interactions, and attributes of generic Peace Operation Missions. Peace Making, Peace Building and Peace Support. GMU's Institute of Public Policy recently completed an in-country pilot study to develop a critical path model (CPM) for the Liberian elections based on the CMPO sub-model paradigm. Version 1.0 was delivered to OSD/PA&E in September 1996. Version 1.5 will be demonstrated.

The Tank Battle Attrition Timeline

Judy Rosten
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PURPOSE: Graphically analyze and display an instrumented force-on-force tank battle data. The chart portrays each combatant, each engagement, over time and distance.

DATA: Data input to the analysis comes from Real-time Casualty Assessment (RTCA) instrumentation and real-time positioning instrumentation.

USE: The tank battle chart facilitates visualization and understanding of the actual field events. Instrumentation generates gigabytes of data. This data exists on magnetic tapes and on stacks of printouts. The data volume without graphic display made analysis very difficult. The chart was ready within 3 hours of the end of the instrumented battle and assists the Army study causes of fratricide. The Statistical Analysis System (SAS) software and a drum plotter were used.

PRESENTATION: Presentation includes 3 video segments: (1)TEXCOM the US Army's testing agent. (2)The M1A2 Abrams main battle tank in live fire and instrumented battle. (3)The instrumented tank battle from inside the tank.

Test Planning and Analysis Methodology for the Joint Countermine Advanced Concept Technology Demonstration

Mr. **Ronald R. Luman** and Mr. **I. Dennis Rapport**
The Johns Hopkins University Applied Physics Laboratory

This poster paper will illustrate and describe the philosophy and approach developed by The Johns Hopkins University Applied Physics Laboratory and the Joint Countermine ACTD Joint Program Office to conduct and analyze this ACTD. This ACTD includes test and evaluation of a dozen novel countermine systems, demonstration of an improved C^4I architecture, and the employment of a sophisticated modeling and simulation tool. Data collection and analysis will be conducted during two large-scale demonstrations, scheduled for August 1997 and May 1998. The approach includes development of a MOE/MOP hierarchy for the system of systems situation, development of an integrated scenario to demonstrate and motivate use of the novel systems, and an innovative use of the enhanced C^4I network as the primary automatic data collection mechanism.

ACTDs are a new and innovative aspect of DoD acquisition reform, just initiated in FY95 by the Deputy Under Secretary of Defense for Advanced Technology [DUSD(AT)]. They represent an attempt to accelerate the acquisition process, and encourage the acquisition community to cooperate earlier and more fully with the intended warfighting user. The objective of the Joint Countermine (JCM) Advanced Concept Technology Demonstration (ACTD) is to demonstrate the capability to conduct seamless amphibious mine countermeasures (MCM) operations from sea to land. The ACTD will consist of two closely-coupled demonstrations integrated into large scale Joint Task Force Exercises (JTFEXs), employing prototypes from ATDs and developmental acquisition systems alongside operational forces utilizing current countermine systems. Extensive operational user (USACOM) involvement in the ACTD supports the development and evaluation of doctrine, tactics, techniques, procedures, and the assessment of organizational impacts of the new technology prototypes.

The Joint Countermine (JCM) ACTD is a "system of systems," with complex interfaces among the novel systems being evaluated in the ACTD as well as inter-relationships with the legacy countermine systems that are currently fielded. The challenge for planning the test and evaluation approach for the JCM ACTD is to give the users the proper observability into the military utility of the novel systems to allow them to make the right decisions with respect to those systems. The demonstration planning and evaluation approach developed for this ACTD has been recognized by OSD and USACOM as being applicable to other ACTDs of the systems of systems class. The approach we will present in the poster paper has been recommended to other ACTD managers.

Demonstration of a Ground-based Acoustic Sensor Network Model and its Implementation in a Force-on-force JANUS Simulation

Angela Stich, Gail Halverson, John D. Pinder and LCDR Randall G. Bowdish
RAND
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Phone: 310-393-0411 ext 6523

Advanced acoustic sensor networks are capable of detecting, locating, tracking, classifying and, in some cases, identifying military ground vehicles on the battlefield. Such networks may also be able to automatically locate enemy artillery with targeting quality precision. This poster session will demonstrate an advanced acoustic sensors model, which was developed at RAND, and integrated into JANUS for force-on-force military simulation. The demonstration will begin by showing the area covered by an individual acoustic sensor, and a specified network configuration of acoustic sensors, given a range of accuracy requirements and environmental conditions. This will be followed by a real-time run of the acoustic sensor network model, in its stand-alone mode, in which it provides a series of acoustic pictures of the battlefield over time, including estimates of the location and classification of potential targets. The demonstration will be concluded with a JANUS simulation that will illustrate (1) the different types of acoustic detection classifications, (2) the potential errors in acoustic target location estimates, due to limitations on bearing accuracy, resolution, and association, and (3) the manner in which acoustic target information is passed into the command and control chain.

Automated NBC Hazard Prediction Tools: Comments from the Field

Karl Stuempfle
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In September of 1996, the Joint Warning and Reporting Network-Prototype (JWARN-P) was delivered to European Command (EUCOM) and US Army Fifth Corps in Germany. JWARN-P was in response to a EUCOM request for an automated Nuclear, Chemical, and Biological Warning and Reporting System (NBCWRS), and staff decision aid to be used by chemical staffs. It is an interim solution using several government and commercial off-the-shelf (GOTS, COTS) hazard prediction, warning and reporting, and database programs on laptop computers, meant to provide an initial operational capability until the developmental JWARN is fielded.

As fielded the system consists of a Laptop running the following GOTS/COTS programs: D2PCw, HPAC and VLSTRACK (all GOTS hazard prediction programs that handle some combination of N, B, or C hazards); NBC Analysis (COTS program that automates the NBC Warning and Reporting system); and CABO (COTS database of NBC weapons, agents, incidents, and proliferation data).

This poster session demonstrates the JWARN-P and describes the integration and training process required before its fielding.

The Master Environmental Library: The Status of Your Online Gateway to Environmental Information

Dr. Fred C. Newman
The Johns Hopkins University
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The Master Environmental Library (MEL) is being developed by the Defense Modeling and Simulation Office as an online resource of global environmental information to support representation of the natural environment in advanced computer simulations and to support the national decision maker and the warfighter. The MEL is an internet-based system providing the user a single point of access through a powerful HTML or JAVA interface to a growing number of geographically distinct sites possessing environmental information, data, and products. The MEL facilitates discovery, access, subscription, and delivery through a single interface to meet the user's environmental requirements. Access to classified data via MEL will be available in the near future. The MEL Program is currently investigating opportunities and making plans for transition to long term operational status.

Demonstrations — Daily during symposium
Tuesday, Wednesday, Thursday

Tuesday, 1030 - 1700.. **Safety Center Bldg**

Virtual Reality Combat Network Battle Management and Analysis Tool

Mr. John Brand
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The Army Research Laboratory (ARL) is charged with basic research in defensive information warfare. Part of this responsibility involves network management under combat conditions. A virtual reality network management and analysis tool inspired by a tool reported initially by British Telecom, is being developed for ARL under a Small Business Innovative Research (SBIR) contract by Quality Research, Inc. The tool, the Virtual Reality C3 Net Management Tool, acts as a data management and display device, acquiring information on net status in a variety of ways, processing the network status information, and displaying it in a two-dimensional planform, superimposed on digitized three-dimensional map data, perspective view from a steerable viewpoint, or in three-dimensional color, real-time virtual reality, using display goggles. This will allow management of a net in a real time and post-battle or post-exercise analysis of net performance.

The program is based on commercial virtual reality tools. The data can be acquired by "eavesdroppng" on an internet/ethernet, by acquiring data from the status reports broadcasted in a distributed information simulation, or by using common network management protocols. The status of the units simulated during a Distributed Interactive Simulation (DIS) environment wargame, or the status of the DSI net itself, may be deduced and displayed in real time or battle time, or stored and played back for later analysis. Net status information may ultimately be derived from interactive simulations such as ModSAF.

The phase I effort will concentrate on construction of the virtual reality tool, display, and data gathering and miniulation modules. The action will be driven by scripts. The University of Alabama (Huntsville) will provide consulting expertise in virtual reality, and GTE will provide expertise in combat nets.

Wednesday, 0830 – 1700 and Thursday, 0830 - 1400.. **Safety Center Bldg**

Conceptual Model of Peace Operations (CMPO)

Coordinators: **Cy Staniec**, LOGICON, Inc
Dr. **Jacqueline Henningsen**, OSD/PA&E

Demonstrations of models and simulations as well as tools related to Operations Other Than War will be demonstrated in an open forum during the symposium. Posters and handouts with specific presentations names, times, and other details will be available during the symposium at the registration desk or at the MORS Headquarters office. A preview of a few of these demonstrations will also be available as part of the Poster Session at the Mixer on Tuesday evening.

Presenter: Mr. **Martin Bradeck**, Institute of Public Policy, George Mason University (GMU)

A demonstration of the Conceptual Model of Peace Operations (CMPO) developed by GMU's Program on Peacekeeping Policy will be provided during the Poster and OOTW Demonstration Sessions. CMPO is a computer model that uses a systems engineering and behavior modeling tool, to specify the relationships, interactions, and attributes of generic Peace Operation Missions. Peace Making, Peace Building and Peace Support. GMU's Institute of Public Policy recently completed an in-country pilot study to develop a critical path model (CPM) for the Liberian elections based on the CMPO sub-model paradigm. Version 1.0 was delivered to OSD/PA&E in September 1996. Version 1.5 will be demonstrated.

Wednesday, 0830 – 1700 and Thursday, 0830 - 1400.. **Safety Center Bldg**

JWARS Prototype Demonstration

Other Special Events

Tuesday, 0715 - 0815..**Little Hall – CR 1**

Working & Composite Group Warm-Up

Jay Wilmeth, Seta Corporation, Coordinator

Wednesday, 0700 - 0800...**The Officer's Club**

Town Hall Breakfast Meeting (WG & CG Chairs)

Wednesday, 0700 - 0800...**The Officer's Club**

***PHALANX* Editor's Breakfast Meeting**

Wednesday, 0700 - 0800...**The Officer's Club**

***Military Operations Research Journal* Editor's Breakfast Meeting**

Wednesday, 1530 - 1700..**MCRC - 134**

ADS SAG Meeting

Dr. **Henry Dubin**, USA OPTEC, Chair

Thursday, 0715 - 0815..**SNCOA - 1**

Joint SAG Meeting

Dr. **Jacqueline Henningsen**, OSD (PA&E), Chair

Thursday, 1530 - 1700..**C&SC - 227**

OOTW Users' Group Meeting

Dr. **Jacqueline Henningsen**, OSD (PA&E) and **Lynda Jaques**, USCINCPAC

This meeting will update participants who attended an April 2, 1997 Analysis Council sponsored conference on M&S for OOTW or the MORS Workshop on MOOTW Analysis and Modeling Techniques about the development of interest group and user's group web sites and further activities. Others with capabilities in this are invited to attend.

Thursday, 1500 - 1530...**Ellis Hall**

Working & Composite Group Wrap-Up

Jay Wilmeth, Seta Corporation, Coordinator

MORS Office

MORS will have an office at Quantico during the 65th MORSS. It will be located at **3094 Upshur Avenue,** ground floor. The office will be open on Thursday, 5 June, Friday, 6 June, and Monday 9 June, 0900-1700; on 10, 11, 12 June, 0700-1730. The phone numbers for the MORS office at Quantico are **703-784-5088**, FAX **703-784-5124**. DSN prefix is **278-**. They will be **activated on 5 June**.

Attendee Support Office: Phones, PC's and Printers

There will be an attendee support area on the first floor of the Marine Corps Research Center (MCRC). When you come into the MCRC through the Broadway Street entrance, take a left into the Library area. There will be 8 PC's available to MORSS attendees which will have telnet access. There will be 2 PC's with Word Perfect and Power Point and a printer for use by attendees.

Phones will be available for attendee use in Rooms 135, 139 and 140 of the MCRC. They will have autovon and credit card access. In addition, pay phones are located throughout the buildings at the Marine Corps Base Quantico.

Government Quarters

A limited number of quarters are available at Quantico. Call Liversedge Hall at 703-784-3148/3149; DSN 278 or Crossroads Inn at 800-965-9511 to make a reservation. If you choose not to stay on the base, you should specify Quantico, Virginia as the TDY destination, with the following disclaimer provided in Block 16 of DD Form 1610: ***"Use of Government facilities would adversely affect the performance of the assigned mission."***

Statements of Non-availability

Statements of non-availability WILL NOT be provided.

Lost and Found

The Lost and Found will be in the MORS office, 3094 Upshur Avenue, during the Symposium. Lost and Found items not claimed at the end of the Symposium will be left with the host facility.

Mixer

There will be an informal mixer at the Clubs of Quantico, on Tuesday evening, 10 June, from 1715-1900. There will be a cash bar. Transportation will be provided back to the hotels before and after the mixer.

Picnic and Parade

On Wednesday evening, 11 June, there will be a picnic at Barnett Field, starting at 1700. The menu includes grilled chicken, hamburgers, salads, beans, iced tea and lemonade. There will be a cash bar available. At 1900, we will be treated to the US Marine Corps Battle Color Ceremony, which includes the Drum & Bugle Corps, the Silent Drill Team and the Color Guard. The ceremony lasts approximately 55 minutes.

The cost of the Picnic is $15.00 per person. Tickets MUST be purchased in advance and the cost is non-refundable. Transportation will be provided to the hotels and Pentagon after the Parade.

Lunches and Snacks

The following facilities are available for lunch:

- The Clubs of Quantico -- shuttle bus transportation will be provided.
- Golf Course Snack Bar
- PX area including MacDonald's (shuttle bus from Lejuene Hall lot)
- Many restaurants are located within the Town of Quantico and outside the main gate.
- Box lunches will be delivered to Ellis Hall and to the Staff NCO Academy at 1130 for those who have ordered them.

Coffee

Coffee and snacks will be provided without additional charge. Coffee will be served on Tuesday, Wednesday and Thursday at the following times:

0700-0830	**1000 – 1030**	**1500-1530**

Designated Smoking Areas

Smoking is NOT permitted in any building at Quantico. The designated smoking areas are located outside each building.

Bus Transportation from Hotels and *Pentagon* to Quantico Marine Corps Base and Back

DAY						
TUESDAY	**Depart Hotels**	**Arrive Quantico**	**Depart Quantico**	**Arrive Hotels**	**Depart Mixer**	**Arrive Hotels**
	0615	0700	1715	1800		
	0700	0745			1900	1945
	Depart Pentagon	*Arrive Quantico*	*Depart Quantico*	*Arrive Pentagon*	*Depart Mixer*	*Arrive Pentagon*
	0600	***0700***	***1715***	***1815***	***1900***	***2000***
WEDNESDAY	**Depart Hotels**	**Arrive Quantico**	**Depart Quantico**	**Arrive Hotels**	**Depart Picnic**	**Arrive Hotels**
	0615 *	0700	1715	1800		
	0700	0745			2030	2115
	Depart Pentagon	*Arrive Quantico*	*Depart Quantico*	*Arrive Pentagon*	*Depart Picnic*	*Arrive Pentagon*
	0600 *	***0700***	***1715***	***1815***	***2030***	***2130***
THURSDAY	**Depart Hotels**	**Arrive Quantico**	**Depart Quantico**	**Arrive Hotels**		
	0615	0700	1515	1600		
	0700	0745	1715	1800		
	Depart Pentagon	*Arrive Quantico*	*Depart Quantico*	*Arrive Pentagon*		
	0600	***0700***	***1515***	***1615***		
			1715	***1815***		

Italics denotes buses to and from the Pentagon.

Buses from Pentagon pick-up at Holiday Inn Express at 0625.

*** Stops en route at Club to drop off Working Group/Composite Group Chairs for Town Hall Meeting and PHALANX and Journal Editors for Breakfast Meetings.**

Security Matters

Attendees are reminded of the necessity for continuing attention to security precautions. While every effort will be made to provide a secure facility for the meeting and to insure that attendees are properly identified, cleared, and in possession of the required need-to-know, all are reminded that the responsibility for the unauthorized disclosure, particularly with regard to conversations, rests with the individual attendee. Attendees are requested to keep in mind the following important points:

1. Be careful WHERE you make classified disclosures. Do not extend classified discussion to hotels, restaurants, officers' clubs, or other places in which you are unable to positively identify all within hearing distance and be reassured of the nonexistence of eavesdropping devices.

2. Be careful TO WHOM you make classified disclosures. You should assure yourself that the people to whom you are talking are indeed registrants at the 65th MORSS. You are advised that a uniformed or civilian person located away from the restricted area of the meeting and not personally recognized as a registrant does not have authorized access to classified information, regardless of his possession of a MORS name badge.

3. The attention of non-government attendees is invited to the NISPOM, Chapter 5, Section 5, with regard to disclosure authorizations.

4. Attendees are advised that possession of photographic, audio recording or electronic transmitting devices is not authorized in the meeting spaces of the 65th MORSS.

Admission Policy

Admission to the secure area of the meeting is limited to holders of current printed invitations properly authenticated and issued by the MORS office to the named individual for his attendance at the 65th MORSS.

Persons who enter or attempt to enter the secure area of the meeting without proper invitation and persons who aid, encourage, or willfully permit improperly unauthorized persons to enter the secure area of the meeting are liable for citation for security violation.

Invitations

The only admissible invitation is the official 65th MORSS Invitation issued by the MORS Office. Other invitations, including official invitations for earlier MORSS, are inadmissible. There is no provision for one-session-only invitations and MORS has no obligation to issue invitations after the announced deadline or to work out invitations for persons who arrive uninvited at the meeting. ***Invitations must be brought to the meeting. They are required for registration.***

Restricted Meeting Areas

Those portions of the meeting area lying inside of the posted guards are designated restricted meeting areas for the 65th MORSS. All classified presentations and discussions in connection with the MORSS program are to be conducted inside this area. Only the following persons are permitted access to MORS meeting areas:

- Officially invited 65th MORSS attendees with appropriate MORS-issued name badges and approved ID cards;
- MORS staff and service personnel with appropriate MORS-issued name badges and approved ID cards;
- Members of the 65th MORSS guard force;
- Officials representing the host command on official business.

Entry to the Meeting Areas

Entry to the restricted meeting areas will be regulated by the guard force and working group chairs and cochairs.

At each entry to the meeting area, each attendee will be required to stop long enough to show his properly validated 65th MORSS name badge and his identification and to be recognized by the guards. The name badge and ID card should be displayed at all times within the restricted meeting area. The guards or working group chairs and cochairs will check the following before admitting an attendee to the classified area:

- The validity of the ID card
- The validity of the name badge
- The correspondence of face and ID picture
- The correspondence of name on badge and ID card.

So that the ID check can be accomplished quickly, name badges and ID cards must be displayed together in the MORS name badge holder.

PLEASE NOTE: Cameras and tape recorders are not allowed in the classified areas at the Symposium.

Picture ID Cards

All attendees in the restricted meeting areas are required to display their ID cards in the MORS badge holders along with their name badges. Only two types of ID cards are permissible: the active duty military ID card and the ID card issued by MORS. The MORS-issued ID cards

will be delivered to the attendees when they register. It is important that the attendee return the card to the MORS office when leaving the meeting. Otherwise, the attendee will have to obtain a new ID card for subsequent MORSS.

MORS Name Badges

A MORS name badge is issued to each properly registered attendee, along with a plastic pouch for its display. Attendees should take care that the badge is not lost or loaned during the meeting as these are avenues for improper entry and security violations. Badges should not be changed, corrected, or altered in any way. If such action is necessary, a member of the MORS staff will issue and authenticate a new badge at the MORS Office at Quantico.

Note Taking

Classified presentations shall be delivered orally and/or visually. Classified documents shall not be distributed and classified note-taking and electronic recordings shall not be permitted by attendees during classified presentations.

Classified Matter — Transmittal

Those desiring to send classified material in advance of their arrival should address it (for attendee pickup) in the following manner:

CG. MCB Quantico (B013)
ATTN: CMCC (MORSS)
3300 Russell Road, Rm 310
Quantico, VA 22134-5129

The lower left corner of both the outer and inner envelopes should show the following information:

Hold for MORSS Attendee:
Your Name
Your Company or Organization

MCCDC will provide your package to the MORS Office at Quantico where you may retrieve it when you arrive at the Symposium, after 1000 on Tuesday, 10 June 1997.

Please note: Capability to perform *major* reproduction of your materials once you arrive at Quantico WILL NOT be provided.

When no longer needed for the Symposium, attendees may bring their classified material to the MORS office to be wrapped for hand carry or transmittal to their parent activity. ***The attendee is responsible for providing a letter of transmittal to be included in the package.*** The meeting security staff will be responsible for proper wrapping and marking of inner and outer envelopes in accordance with Navy security regulations. The address for classified mail shown on the attendee's personal security voucher will be used for mailing purposes. MORS will accept responsibility for mailing a properly wrapped and sealed package by registered mail and will provide the attendee with a receipt for the sealed package. Because of congestion, MORS staff will not be able to wrap packages during the breaks between sessions.

Classified Matter — Overnight Storage

The MORS office will accept (until 15 minutes after the end of the last session) and safeguard (for the meeting duration) classified matter to the level of SECRET. Material will be accepted as a package rather than loose. Receipts must be presented on recovery of material by its holder. The MORS office staff is cleared to the SECRET level.

Classified Matter — Late Arrival

In the event that you arrive late at Quantico during the non-duty hours and need to store classified material, proceed to the Command Duty Officer (CDO) located in Lejeune Hall. Lejeune Hall can be found by entering through the Russell Road Gate (exit #148 off I-95), proceeding approximately 2.4 miles, and making a left turn on Catlin Avenue. Lejeune Hall is the first building on the right hand side. The CDO will notify the duty clerk from the Classified Material Control Center (CMCC), who will store the classified material overnight and deliver it to the MORS Office the next morning.

Classified Disclosure

Persons participating in the discussions at the 65th MORSS have been granted limited disclosure authorization via their personal security vouchers for the 65th MORSS. It is the individual responsibility of each participant to find out in advance, from his certifying official, the limits to his own classified disclosures and to stay within those limits at the symposium.

A written disclosure authorization is required for all papers and presentations (government and contractor). All disclosure authorizations must be forwarded to the MORS Security Manager prior to the meeting or the presentation will be cancelled.

David Rist and Barchi Prize Awards

MORS offers two prizes for best papers—the ***Barchi Prize*** and the ***Rist Prize***. The ***Rist Prize*** is awarded to the best paper in military operations research submitted in response to an announcement and call for papers. The ***Barchi Prize*** will be awarded to the best paper from the entire symposium, including Working Groups, Composite Groups, and General and Special Sessions.

David Rist Prize: Papers submitted in response to the announcement and call for papers were eligible for consideration for the *Rist Prize*. The committee selected the prize-winning paper from those submitted and will award the prize at the 65th MORSS. The author(s) will present the paper at the 65th MORSS and may prepare it for publication in the MORS Journal, *Military Operations Research*. The cash prize is $1000.

MORS Purposes and Objectives

The purpose of the Military Operations Research Society is to enhance the quality and effectiveness of classified and unclassified military operations research. To accomplish this purpose, the Society provides media for professional exchange and peer criticism among students, theoreticians, practitioners, and users of military operations research. These media consist primarily of the traditional annual MORS symposia (classified), their published proceedings, special mini-symposia, workshops, colloquia and special purpose monographs. The forum provided by these media is directed to display the state of the art, to encourage consistent professional quality, to stimulate communication and interaction between practitioners and users, and to foster the interest and development of students of operations research. In performing its function, the Military Operations Research Society does not make or advocate official policy nor does it attempt to influence the formulation of policy. Matters discussed or statements made during the course of its symposia or printed in its publications represent the positions of the individual participants and authors and not of the Society.

The Military Operations Research Society is operated by a Board of Directors consisting of 30 members, 28 of whom are elected by vote of the Board to serve a term of four years. The persons nominated for this election are normally individuals who have attained recognition and prominence in the field of military operations research and who have demonstrated an active interest in its programs and activities. The remaining two members of the Board of Directors are the Past President who serves by right and the Executive Vice President who serves as a consequence of his position. A limited number of Advisory Directors are appointed from time to time, for a 1-year term, to perform some particular function. In addition to the members, the Society maintains a general distribution list of its clientele to whom announcements, newsletters, and information are routinely sent.

The MORS Board of Directors wants to make the meetings and other operations of the Society as responsive as possible, both to the needs of the times and the desires of the members. Consequently, attendees are invited to communicate their relevant ideas and thoughts to any Officer or other Director or to the Society in writing. Where practicable, your communications will be duplicated and furnished to the MORS Board Members and Program Chairs for guidance in respect to future plans and operations.

The following are particularly encouraged:

- Offers of help in future symposium programs and working groups.
- Proposals for establishing new working groups.
- Suggestions for future banquet speakers, keynote speakers, meeting themes, meeting sites, arrangement improvements.
- Criticism of current operations or programs.

The Society will consider all comments, suggestions, and proposals.

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The Quadrennial Defense (QDR) Review

In summer of 1996, Congress, following the initiative of the Commission on Roles and Missions of the Armed Forces, tasked the Department of Defense to prepare a Quadrennial Defense Review (QDR) at the beginning of each Presidential administration. Listed below are some of the sessions during the 65th MORSS that will feature presentations related to the QDR.

Composite Group II
Tuesday, 1030 - 1200, 10 June 1997

RADM Craine, Director Assessment Division (N81)
"Navy Response to the Quadrennial Defense Review"

Special Session 1
Tuesday, 1530 - 1700, 10 June 1997

Mr. Bill Lynn, Director of Program Analysis and Evaluation, OSD
"The Quadrennial Defense Review"
Mr. Paul Davis, RAND
"Looking Beyond the QDR: Analytic Insights and Challenges"

Composite Group VI
Wednesday, 1330 - 1500, 11 June 1997

Honorable Lou Finch, DUSD, Personnel and Readiness
"Resource Issues and Readiness Measures: QDR Assessments and Beyond"

Composite Group - General Interest
Thursday, 1330 - 1530, 12 June 1997

Mr. John Osterholz, Deputy Director of CISA, OSD
"The Challenges of Analyzing the C4ISR Trade Space for the QDR"
Mr. Royce Kneece, Office of the Director PA&E, OSD
"Analysis of a Generic Regional Great Power Scenario"
Dr. Robin Buckelew, Director, Missile Defense Battle Integration Center,
"Army QDR Analysis"
COL Rusty O'Brien, HQ USAF/XO-DAG
"Air Force QDR Analysis"
CAPTAIN T.J. Gregory, USN, The Joint Staff/J-8
"The Baseline Engagement Force Study"

Working Group 6 Littoral Warfare
Thursday, 1415 - 1500, 12 June 1997

Cmdr Kirk Michealson, Office of the Director PA&E, OSD
"CV Crisis Response (A Study in Support of the QDR)"

Building Names and Abbreviations at Quantico

C&CSS — Command & Control Systems School, 2085 Moreel Avenue
(See page C-18)

C&SC — Command & Staff College, 3078 Moreel Avenue
(See pages C-12 and C-13)

DH — Diamond Hall, (Education Facility) 3098 Damato Street
(See pages C-16 and C-17)

Ellis Hall — 2082 South Street
(See Page C-11)

Little Hall — 2034 Barnett Avenue
(See Pages C-6 and C-7)

MCA — Marine Corps Association, Broadway Avenue
(See Page C-14)

MCRC — Marine Corps Research Center, 2040 Broadway Street
(See Page C-10)

MORS Office — 3094 Upshur Avenue
(See Page C-4)

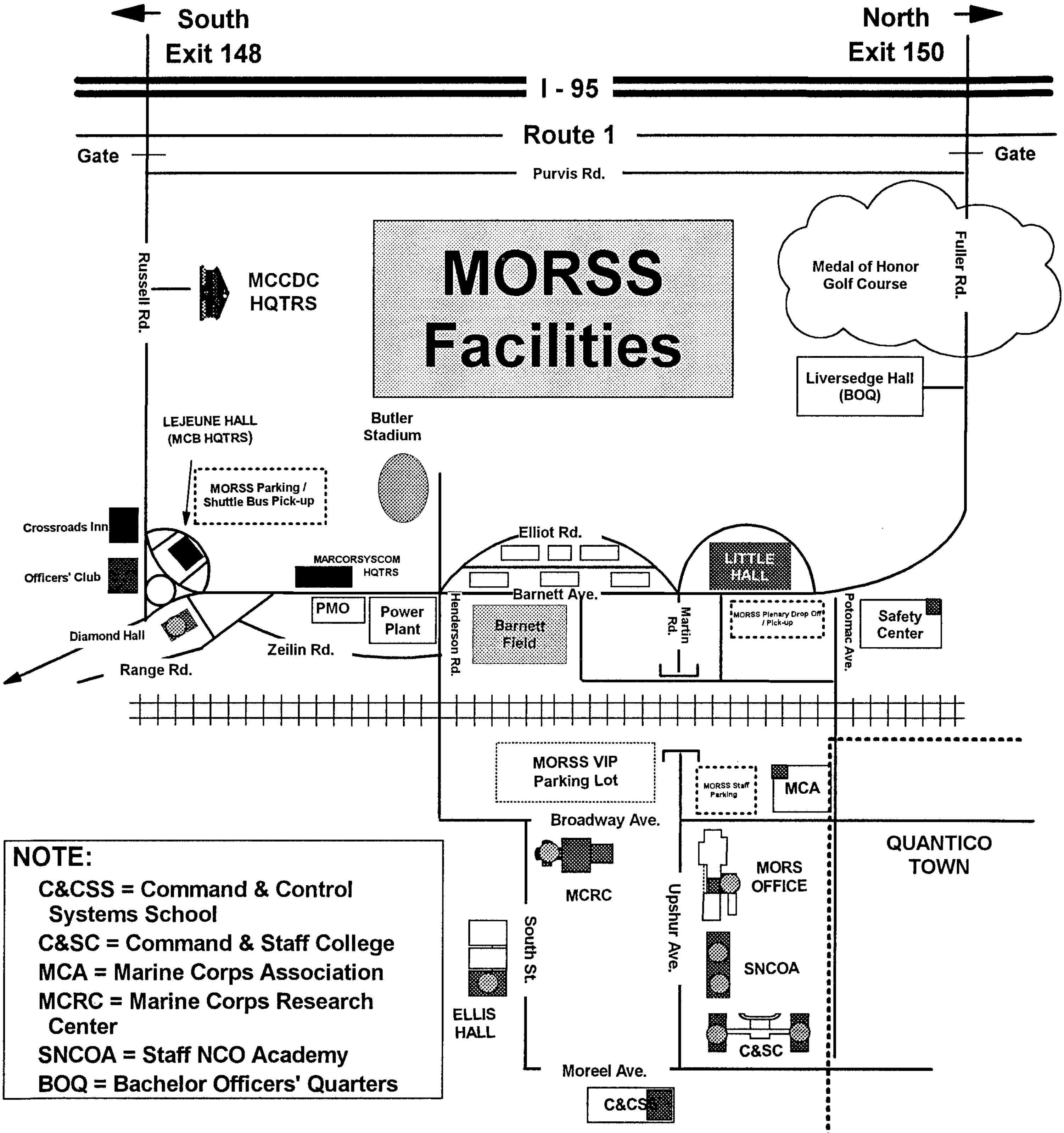
Safety Center — 1001 Potomac Avenue
(See Page C-15)

SNCOA — Staff NCO Academy, 3080 Upshur Avenue
(See Page C-5)

Working Group/Composite Group Room Matrix — See Page C-8 and C-9

Note: Street addresses of buildings are also the building number.

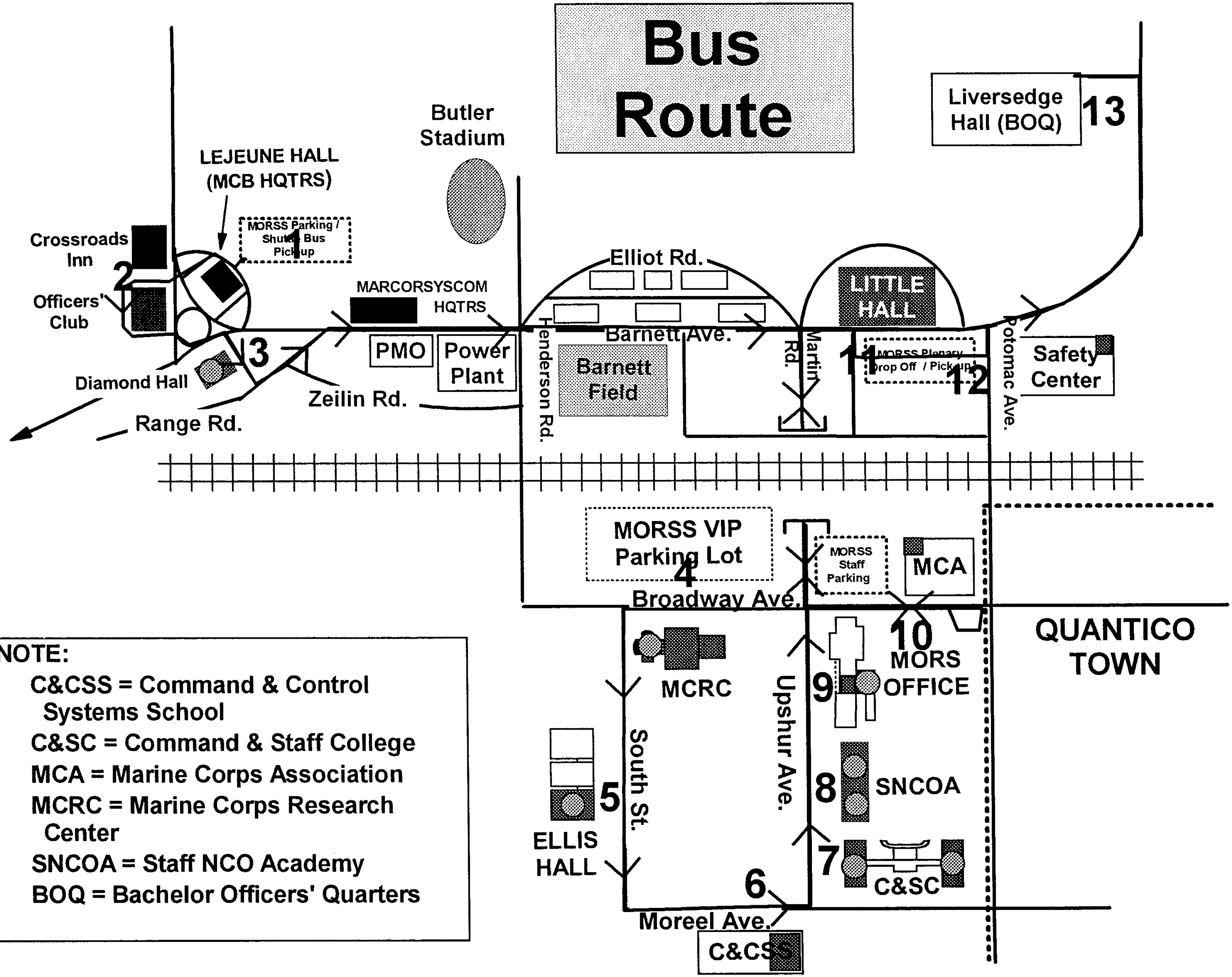
Map of QUANTICO



NOTE:

C&CSS = Command & Control Systems School
C&SC = Command & Staff College
MCA = Marine Corps Association
MCRC = Marine Corps Research Center
SNCOA = Staff NCO Academy
BOQ = Bachelor Officers' Quarters

Bus Route



NOTE:
- C&CSS = Command & Control Systems School
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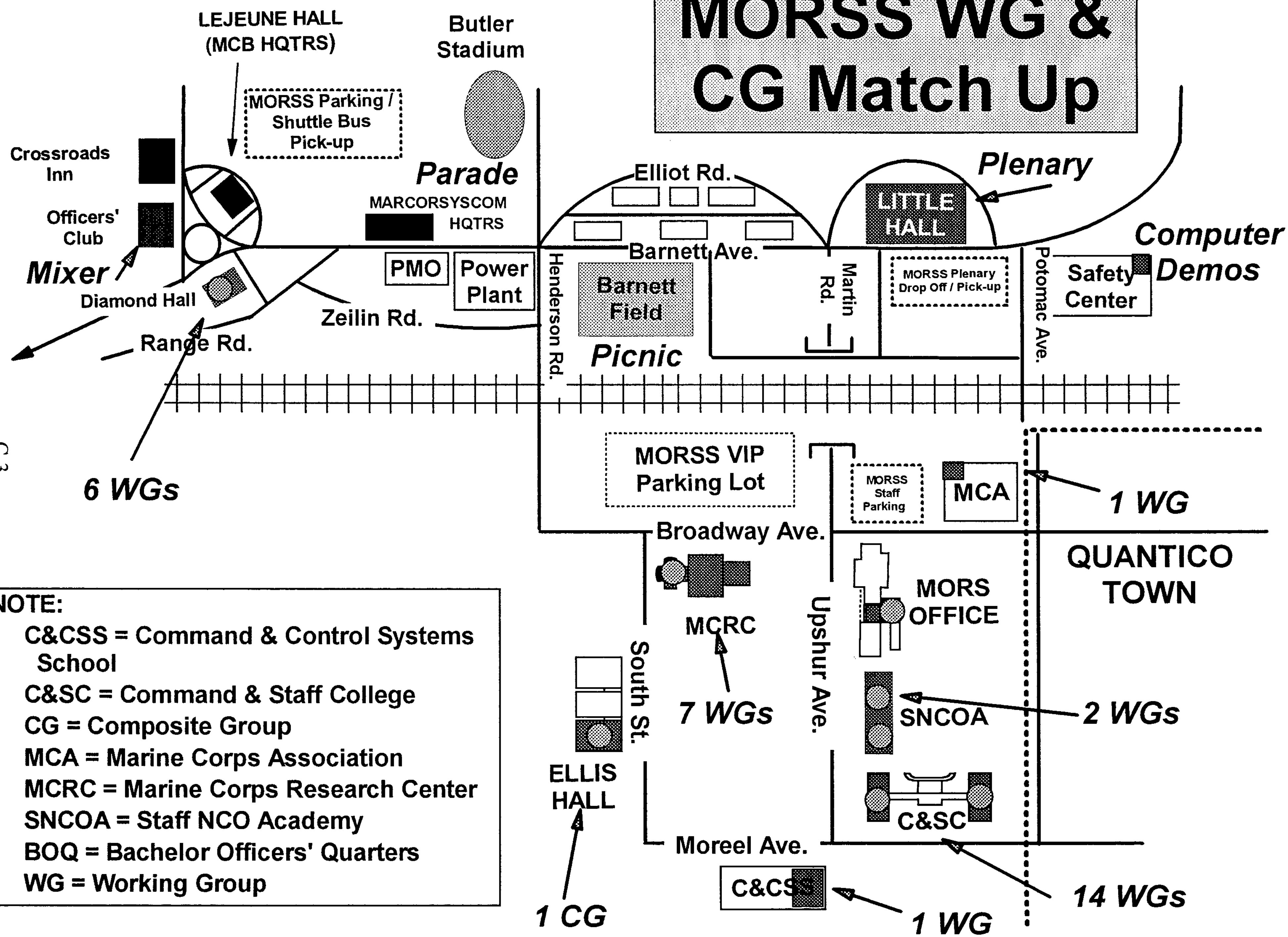
MORSS WG & CG Match Up

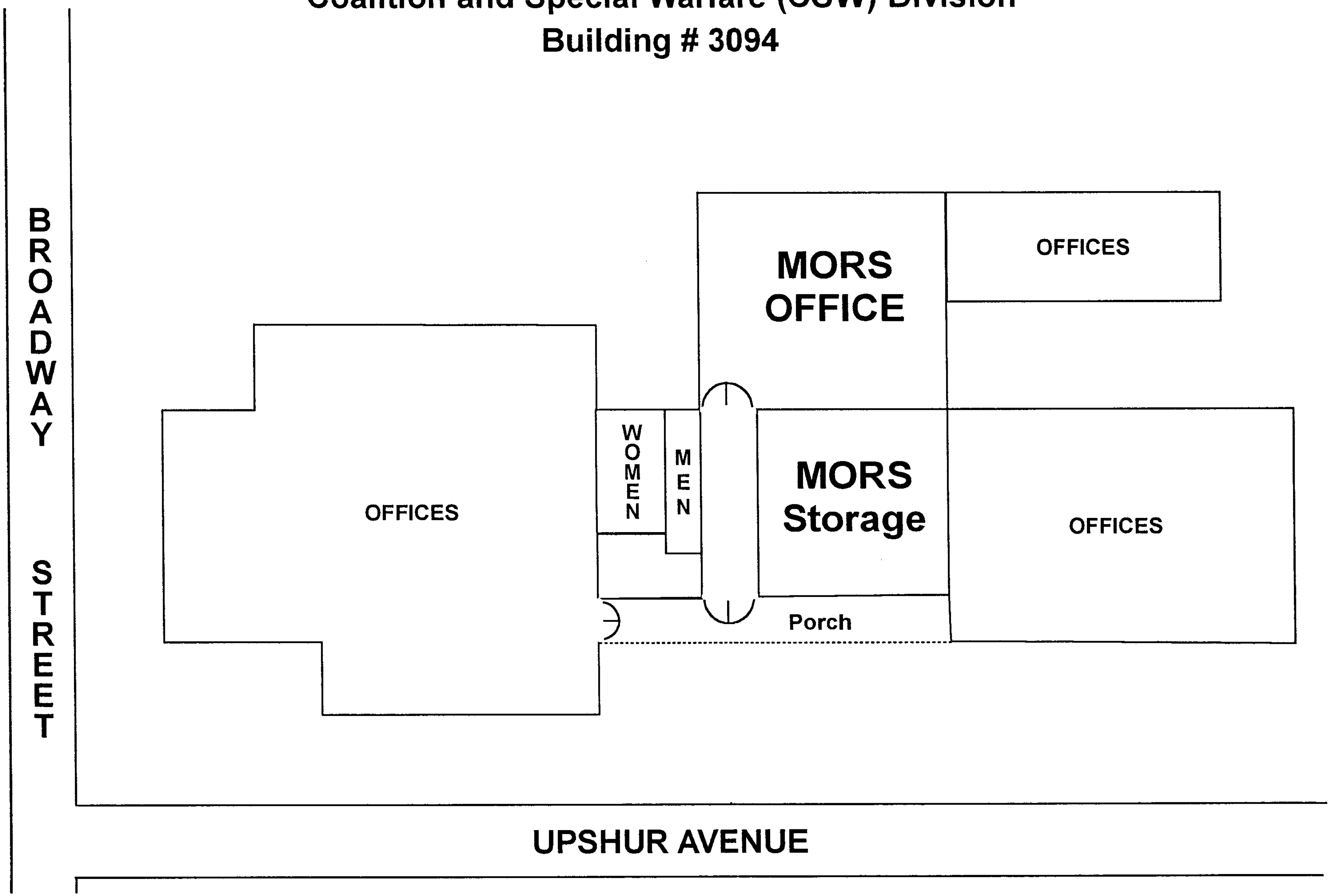


NOTE:

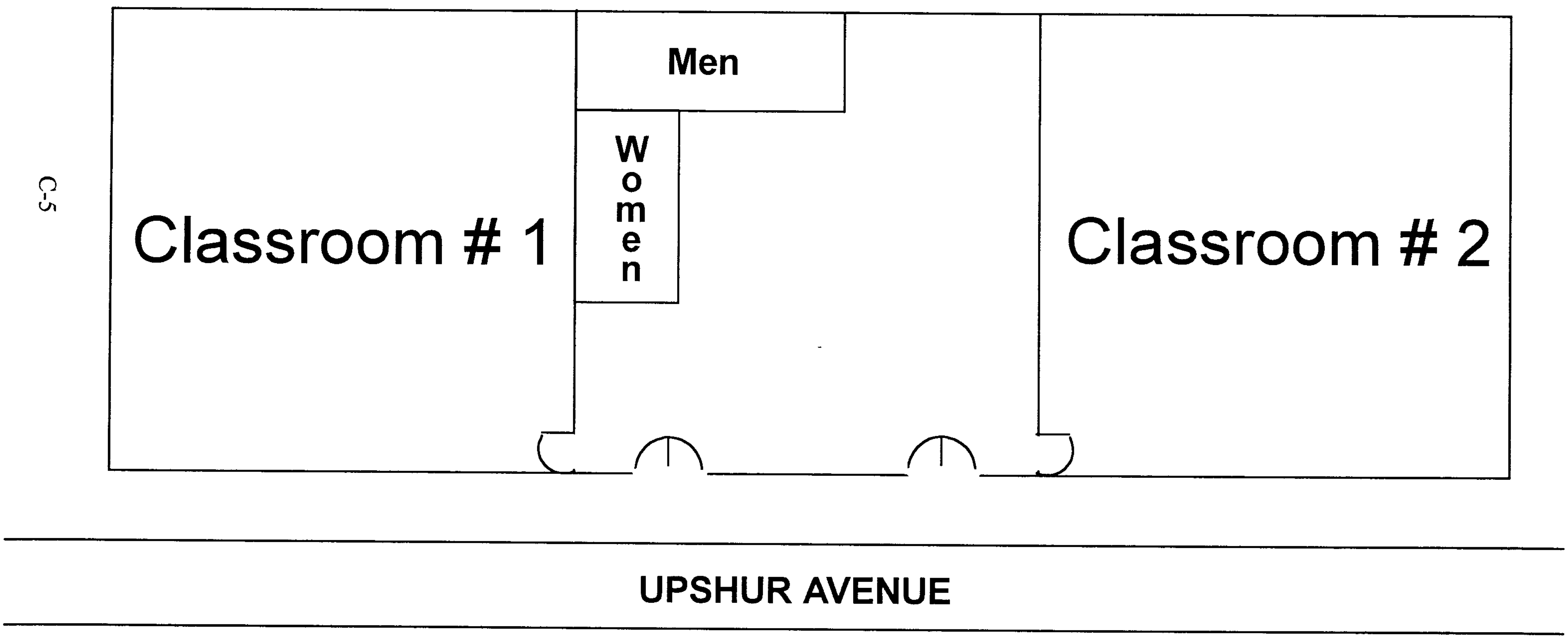
- C&CSS = Command & Control Systems School
- C&SC = Command & Staff College
- CG = Composite Group
- MCA = Marine Corps Association
- MCRC = Marine Corps Research Center
- SNCOA = Staff NCO Academy
- BOQ = Bachelor Officers' Quarters
- WG = Working Group

MORS OFFICE

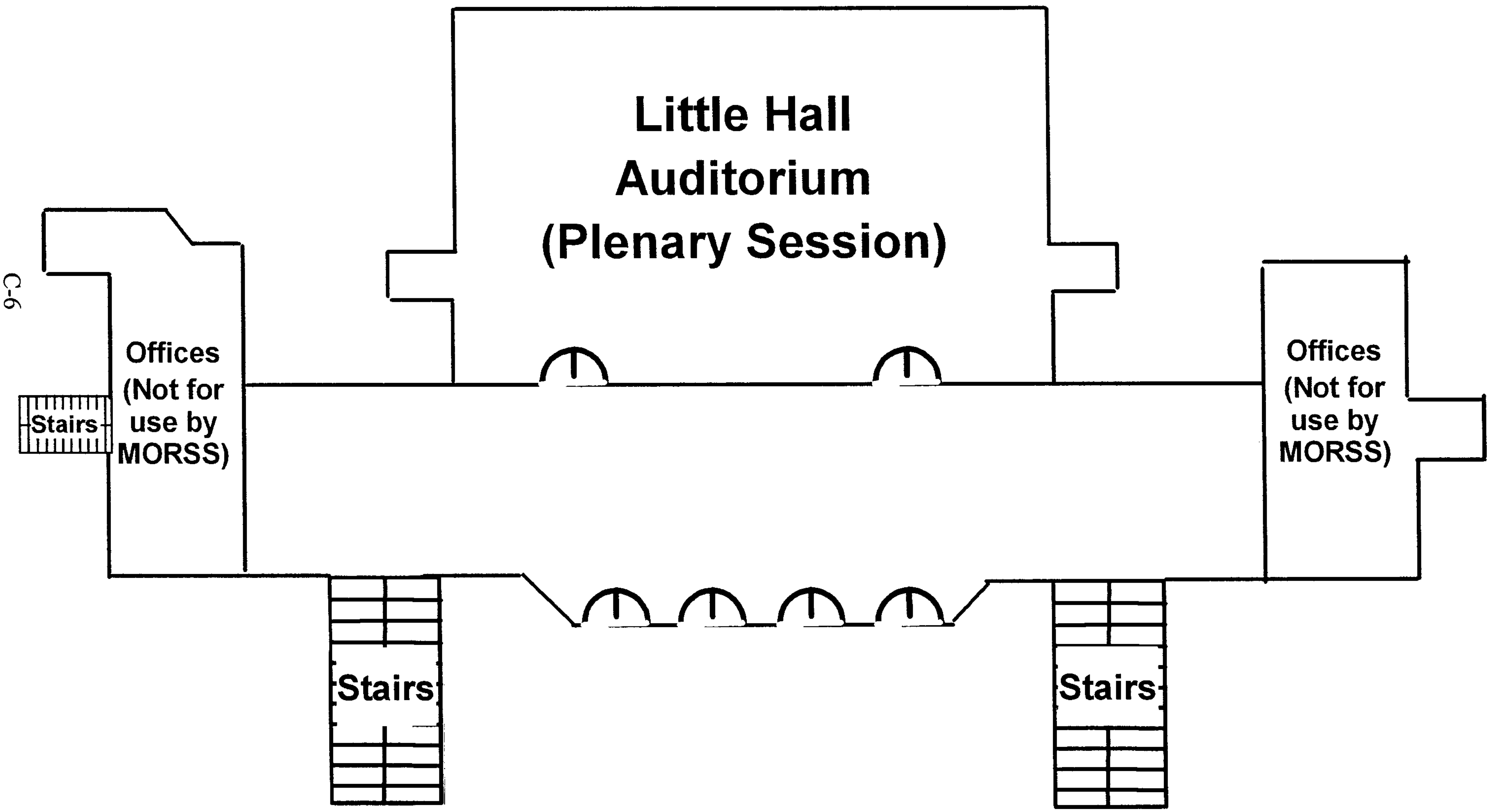
Coalition and Special Warfare (CSW) Division
Building # 3094



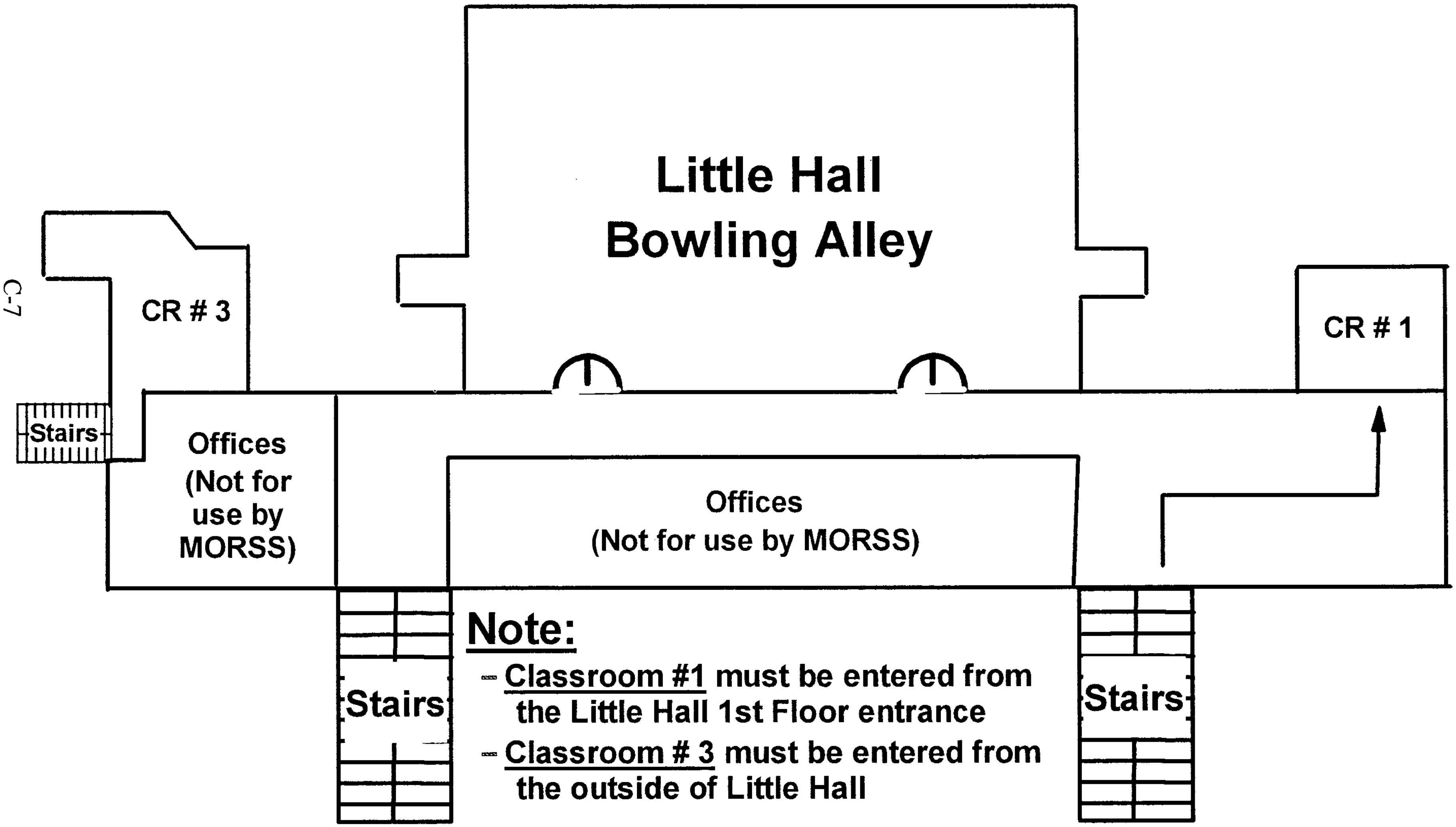
Staff NCO Academy (SNCOA)
Building # 3080



Little Hall
Building # 2034
1st Floor



Little Hall
Building # 2034
BASEMENT



Note:

- Classroom #1 must be entered from the Little Hall 1st Floor entrance
- Classroom # 3 must be entered from the outside of Little Hall

65th MORSS Working Group / Classroom Match Up

Composite Group Number	Working Group Number	TIMES								
		Tuesday						Wednesday		
		0830-1000 Plenary	1030-1200 WGS - 1	1215-1315 T - 1	1330-1500 WGS - 2	1530-1700 SS - 1	1715-1900 Mixer	0830-1000 WGS - 3	1030-1200 SS - 2	1215-1315 T - 2
I	1		C&SC CR #225		C&SC CR #225			C&SC CR #225		
I	3		C&SC CR #102		C&SC CR #102			C&SC CR #102	S	T
I	4	P	C&SC CR #140	T	C&SC CR #140	S	M	C&SC CR #140	P	U
II	5A	L	CG - II (S)	U	DH CR #4	P	I	DH CR #4	E	T
II	5B	E		T	DH CR #5	E	X	DH CR #5	C	O
II	6	N	Ellis Hall	O	DH CR #6	C	E	DH CR #6	I	R
III	7	A	C&SC CR #226	R	C&SC CR #226	I	R		A	I
III	8	R	MCA Conf. Rm	I	MCA Conf. Rm	A		CG - III (S)	L	A
III	9	Y	MCRC CR #164	A	MCRC CR #164	L				L
III	10		MCRC CR #165	L	MCRC CR #165			Ellis Hall	S	
III	11	S	C&CSS Lounge		C&CSS Lounge	S			E	2
III	14	E	SNCOA CR #1	1	SNCOA CR #1	E			S	C&SC CR #228
IV	15	S	DH CR #5		CG - IV (S)	S		MCRC CR #164	S	
IV	16	S	DH CR #1			S		DH CR #1	I	
IV	17	I	DH CR #6		Ellis Hall	I		MCRC CR #165	O	
IV	18	O	DH CR #4			O	O	C&SC CR #226	N	T
V	19	N	C&SC CR #216	(1)	C&SC CR #216	N	F	C&SC CR #216		U
V	20		MCRC CR #166		MCRC CR #166		F	MCRC CR #166	2	T
V	21		MCRC CR #125		MCRC CR #125	1	I	MCRC CR #125		O
V	22		C&SC CR #227		C&SC CR #227		C	C&SC CR #227		R
V	23		C&SC CR #108		C&SC CR #108		E	C&SC CR #108		I
VI	12	L	C&SC CR #103		C&SC CR #103		R	C&SC CR #103	(3)	A
VI	24	I	C&SC CR #109		C&SC CR #109		S	C&SC CR #109		L
VI	25	T	C&SC CR #228		C&SC CR #228	(2)		C&SC CR #228		
VI	26	T	C&SC CR #145		C&SC CR #145		C	C&SC CR #145		2
VI	27	L	DH CR #2		DH CR #2		L	DH CR #2		
VI	28	E	MCRC CR #134		MCRC CR #134		U	MCRC CR #134		
VI	29		MCRC CR #227		MCRC CR #227		B	MCRC CR #227		
VII	30	H	DH CR #3		DH CR #3			DH CR #3		
VII	31	A	C&SC CR #146		C&SC CR #146			C&SC CR #146		
VII	32	L	C&SC CR #147		C&SC CR #147			C&SC CR #147		(4)
VII	33	L	SNCOA CR #2		SNCOA CR #2			SNCOA CR #2		
VIII	2		MCRC Auditorium		MCRC Auditorium			MCRC Auditorium		
VIII	13		C&SC CR #107		C&SC CR #107			C&SC CR #107		

Note:

CS - Composite Session
C&CSS - Command & Control Systems School
C&SC - Command & Staff College
DH - Diamond Hall
MCA - Marine Corps Association
MCRC - Marine Corps Research Center

SNCOA - Staff NCO Academy
SS - Special Session
WGS - Working Group Session
(S) - SECRET CG Meeting
(U) - UNCLASS CG Meeting

(1) T-1 Schedule on Page 7
(2) SS-1 Schedule on Page 2
(3) SS-2 Schedule on Page 4
(4) T-2 Schedule on Page 8

1 of 2

65th MORSS Working Group / Classroom Match Up

Composite Group Number	Working Group Number	TIMES: Wednesday 1330-1500 WGS - 4	Wednesday 1530-1700 WGS - 5	Wednesday 1700-2030 8th & I Picnic	Thursday 0830-1000 WGS - 6	Thursday 1030-1200 SS - 3	Thursday 1215-1315 T - 3	Thursday 1330-1500 WGS - 7	Thursday 1500	Thursday 1530-1700 WGS - 8
I	1	CG - 1 (S)	C&SC CR #227		C&SC CR #227			C&SC CR #227	W	***DONE***
I	3	MCRC	C&SC CR #216		C&SC CR #146			C&SC CR #146	G	***DONE***
I	4	Auditorium	C&SC CR #103	8th	C&SC CR #103	S	T	C&SC CR #103	&	C&SC CR #103
II	5A	DH CR #4	DH CR #4	&	DH CR #4	P	U	DH CR #4	C	DH CR #4
II	5B	DH CR #5	DH CR #5	I	DH CR #5	E	T	DH CR #5	G	DH CR #5
II	6	DH CR #6	DH CR #6		DH CR #6	C	O	DH CR #6		DH CR #6
III	7	C&SC CR #102	C&SC CR #102	P	C&SC CR #102	I	R	C&SC CR #102	C	C&SC CR #102
III	8	DH CR #2	DH CR #1	A	DH CR #2	A	I	DH CR #2	H	DH CR #2
III	9	DH CR #1	DH CR #2	R	DH CR #1	L	A	DH CR #1	A	***DONE***
III	10	C&SC CR #225	C&SC CR #225	A	C&SC CR #225		L	C&SC CR #225	I	C&SC CR #225
III	11	C&CSS Lounge	C&CSS Lounge	D	C&CSS Lounge	S		C&CSS Lounge	R	***DONE***
III	14	C&SC CR #228	C&SC CR #228	E	C&SC CR #228	E	3	C&SC CR #228	S	C&SC CR #228
IV	15	MCRC CR #164	MCRC CR #164		MCRC CR #164	S		MCRC CR #164		MCRC CR #164
IV	16	C&SC CR #145	C&SC CR #145	/	C&SC CR #145	S		C&SC CR #145	/	C&SC CR #145
IV	17	MCRC CR #165	MCRC CR #165		***DONE***	I		***DONE***		***DONE***
IV	18	C&SC CR #226	C&SC CR #226	P	C&SC CR #226	O		C&SC CR #226	C	C&SC CR #226
V	19	C&SC CR #216		I	SNCOA CR #2	N	(6)	Little Hall CR #1	O	***DONE***
V	20	MCRC CR #166	CG - V (U)	C	C&SC CR #216			C&SC CR #216	C	C&SC CR #216
V	21	MCRC CR #125		N	MCRC CR #134	3		MCRC CR #134	H	***DONE***
V	22	C&SC CR #227	Ellis Hall	I	C&SC CR #147			C&SC CR #147	A	***DONE***
V	23	C&SC CR #108		C	MCRC CR #125			MCRC CR #125	I	***DONE***
VI	12		C&SC CR #109		C&SC CR #109			C&SC CR #109	R	***DONE***
VI	24	CG - VI (U)	C&SC CR #108		C&SC CR #108			C&SC CR #108	S	***DONE***
VI	25		MCRC Auditorium		MCRC Auditorium	(5)		MCRC Auditorium		MCRC Auditorium
VI	26	Ellis Hall	C&SC CR #140		C&SC CR #140			C&SC CR #140	W	C&SC CR #140
VI	27		MCA Conf. Rm		MCA Conf. Rm			MCA Conf. Rm	R	***DONE***
VI	28		MCRC CR #166		MCRC CR #166			MCRC CR #166	A	MCRC CR #166
VI	29		MCRC CR #227		MCRC CR #227			MCRC CR #227	P	MCRC CR #227
VII	30	DH CR #3	DH CR #3		CG - VII (S)			DH CR #3		DH CR #3
VII	31	C&SC CR #146	C&SC CR #146					MCRC CR #165	U	MCRC CR #165
VII	32	C&SC CR #147	C&SC CR #147		Ellis Hall			C&SC CR #107	P	C&SC CR #107
VII	33	SNCOA CR #2	SNCOA CR #2					SNCOA CR #2		SNCOA CR #2
VIII	2	SNCOA CR #1	SNCOA CR #1		SNCOA CR #1			SNCOA CR #1	(7)	SNCOA CR #1
VIII	13	C&SC CR #107	C&SC CR #107		C&SC CR #107			CG - VIII (S) Ellis Hall		***DONE***

Note:

CS - Composite Session
C&CSS - Command & Control Systems School
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MCA - Marine Corps Association
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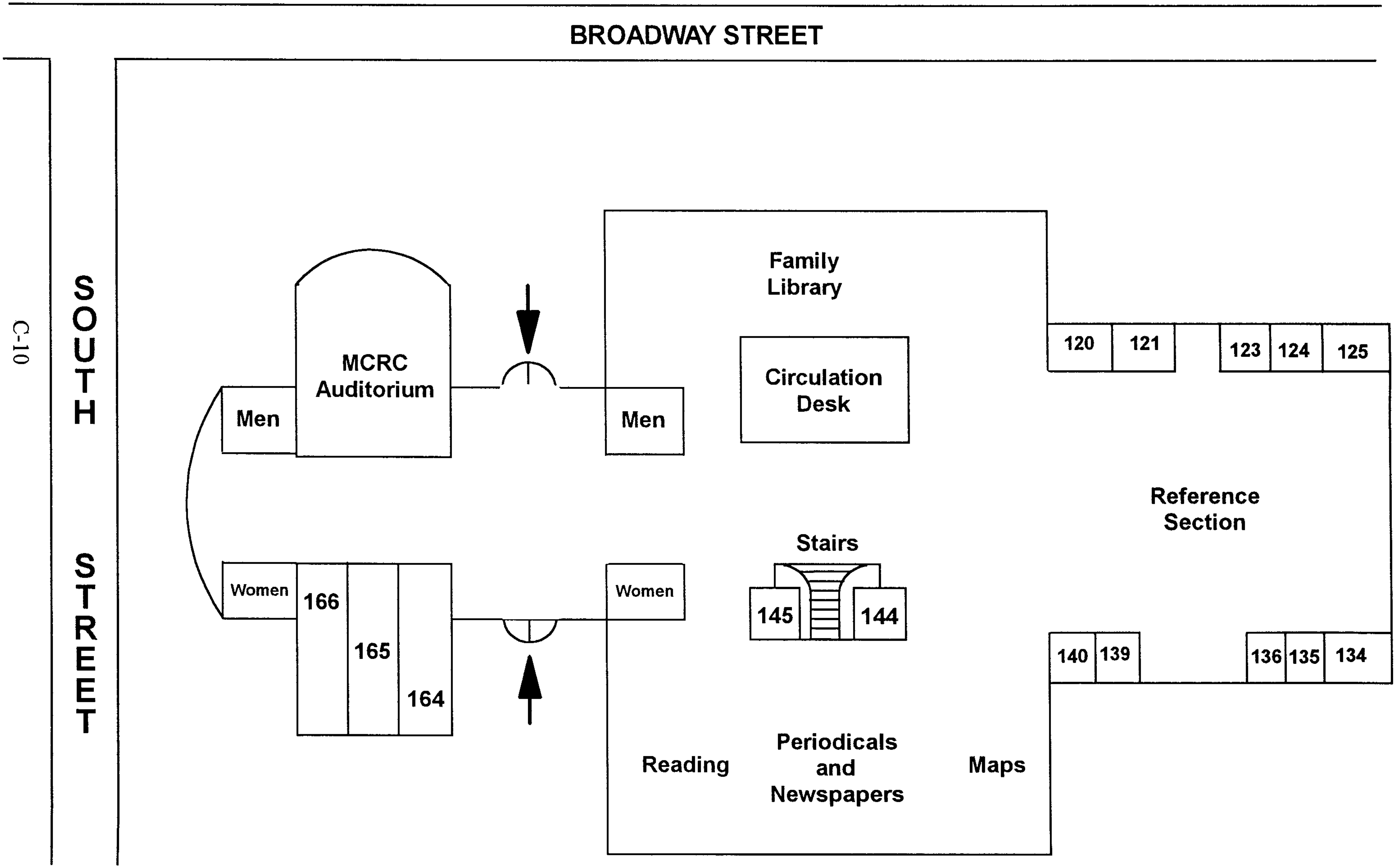
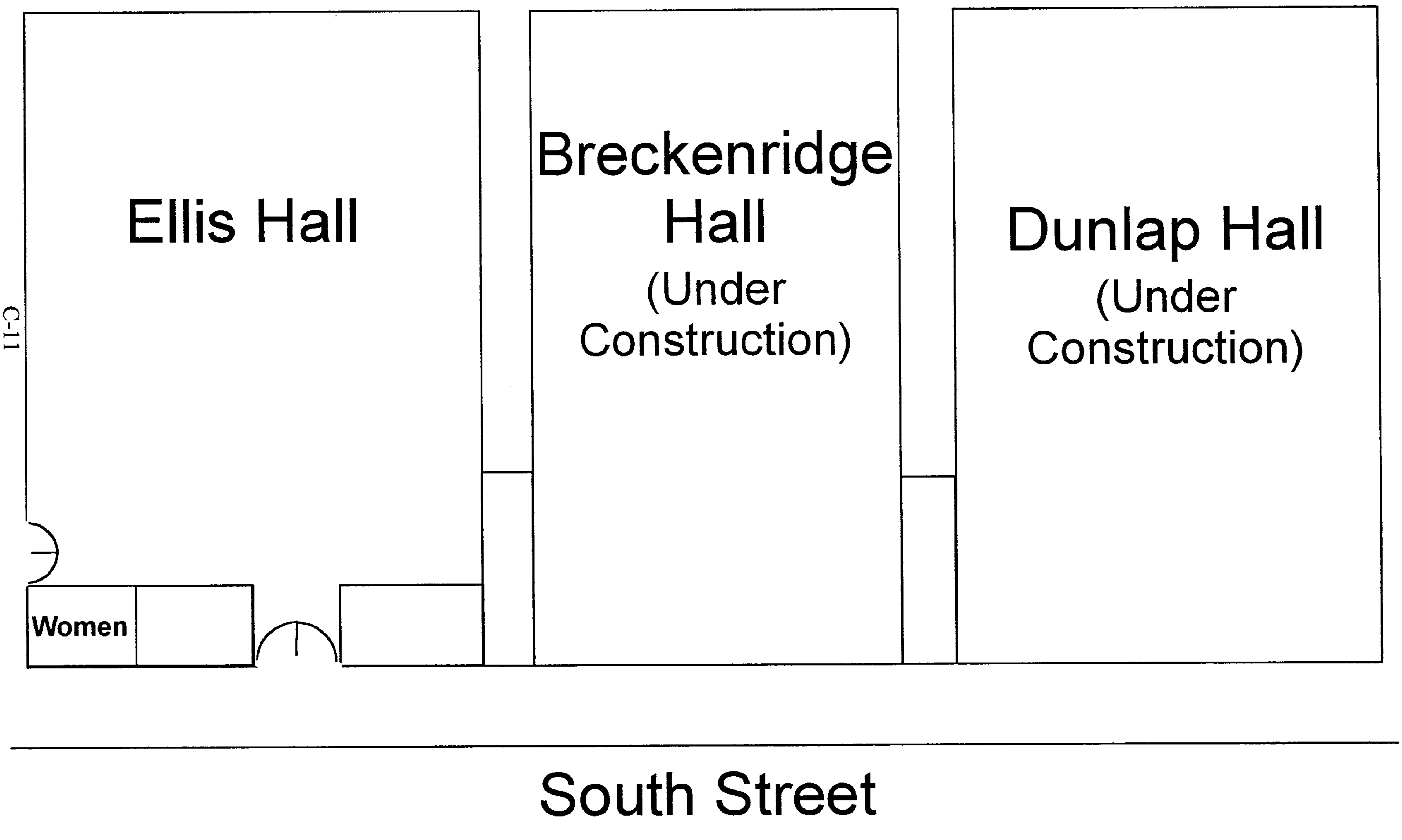
(5) SS-3 Schedule on Page 6
(6) T-3 Schedule on Page 10
(7) Location -- Ellis Hall

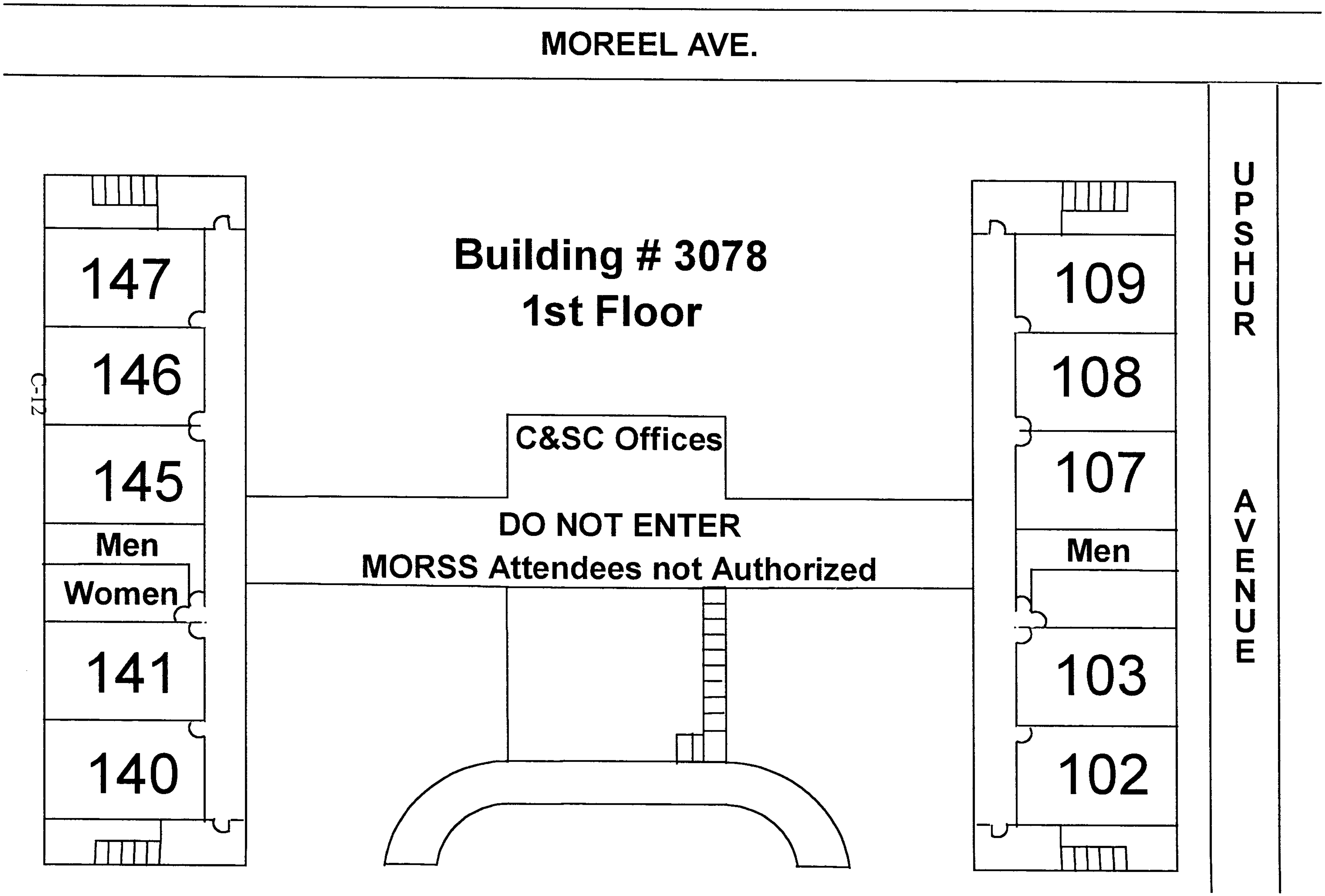
Marine Corps Research Center (MCRC)
Building # 2040
1st Floor



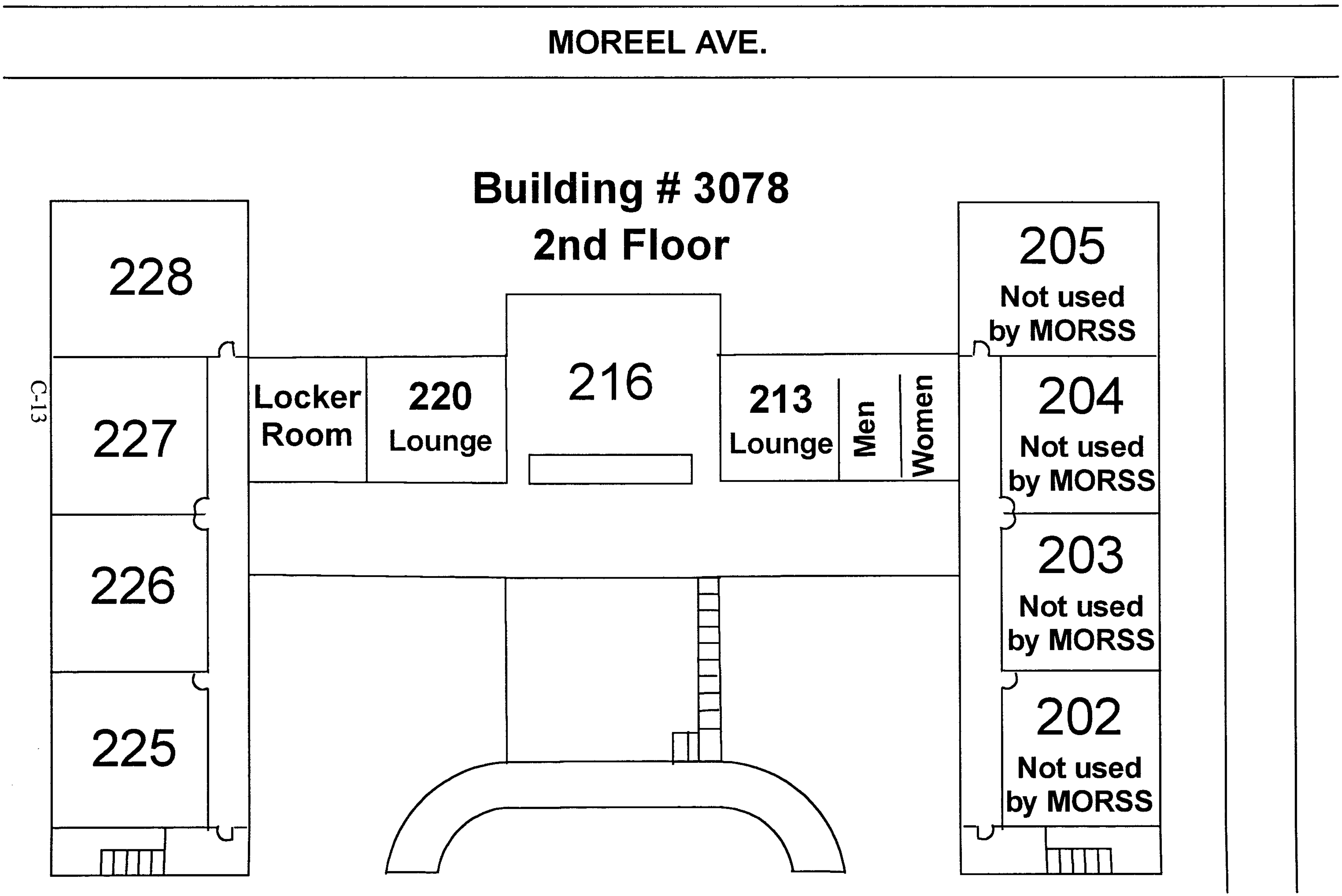
Ellis Hall
Building # 2082



Command & Staff College (C&SC)

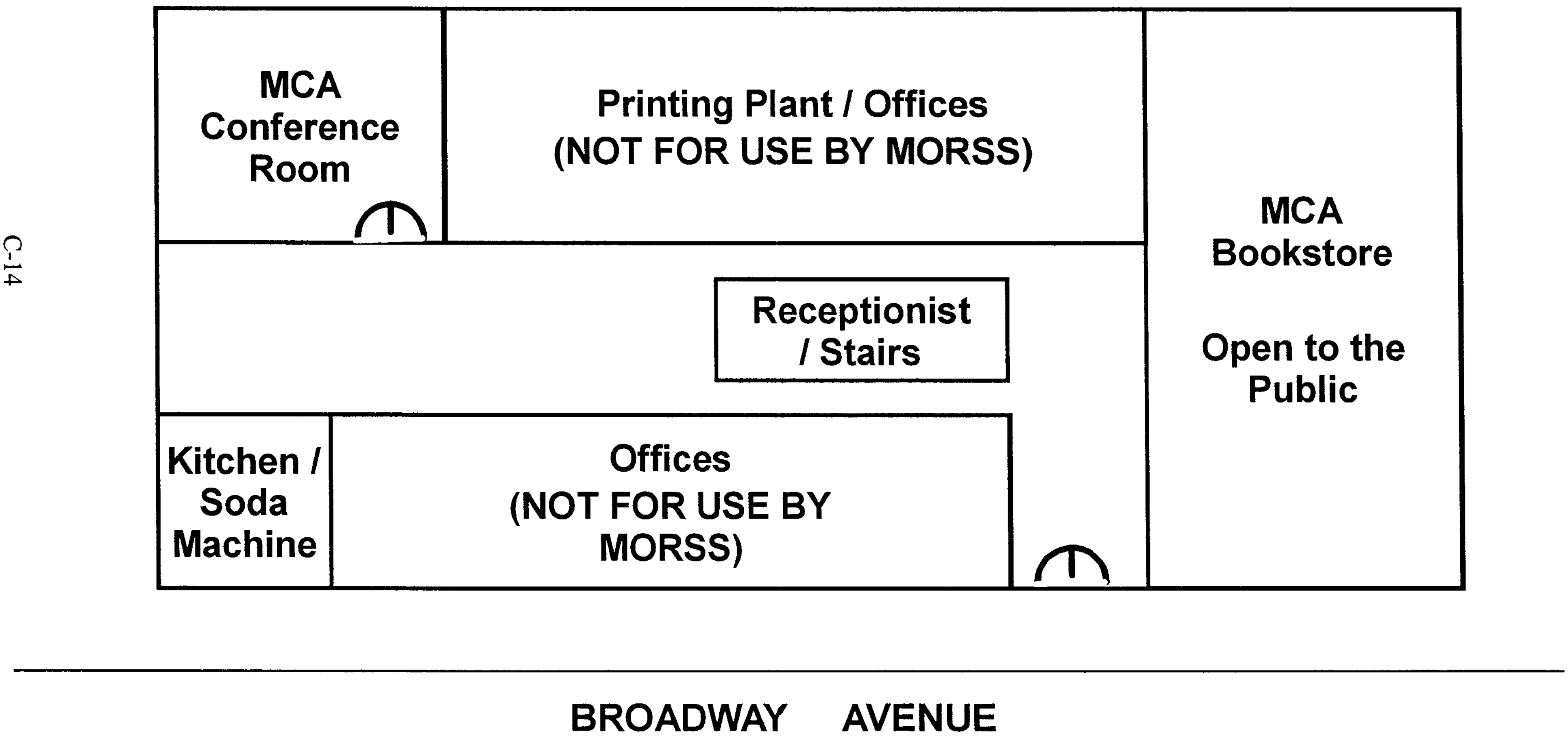


Command & Staff College (C&SC)

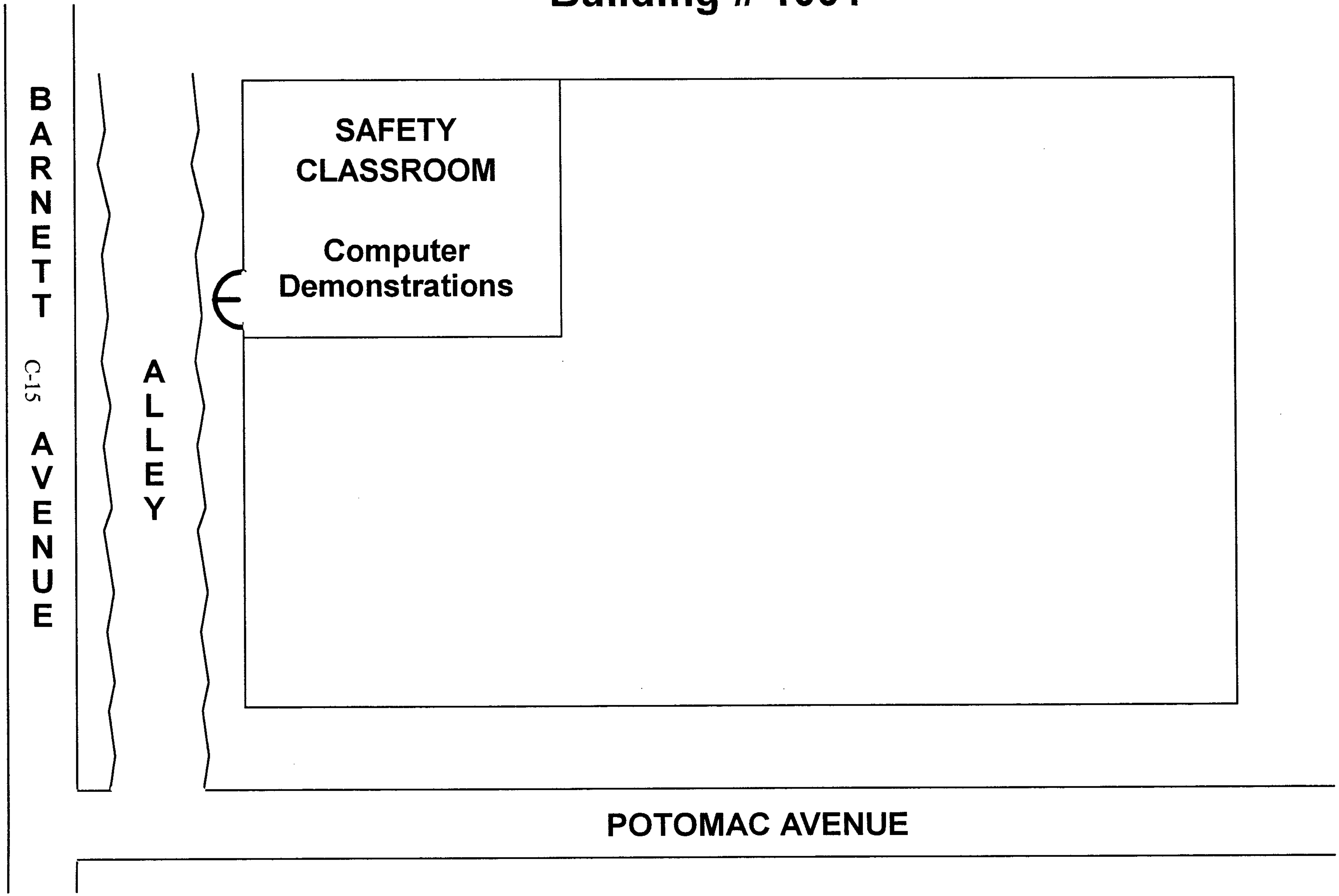


Marine Corps Association (MCA)

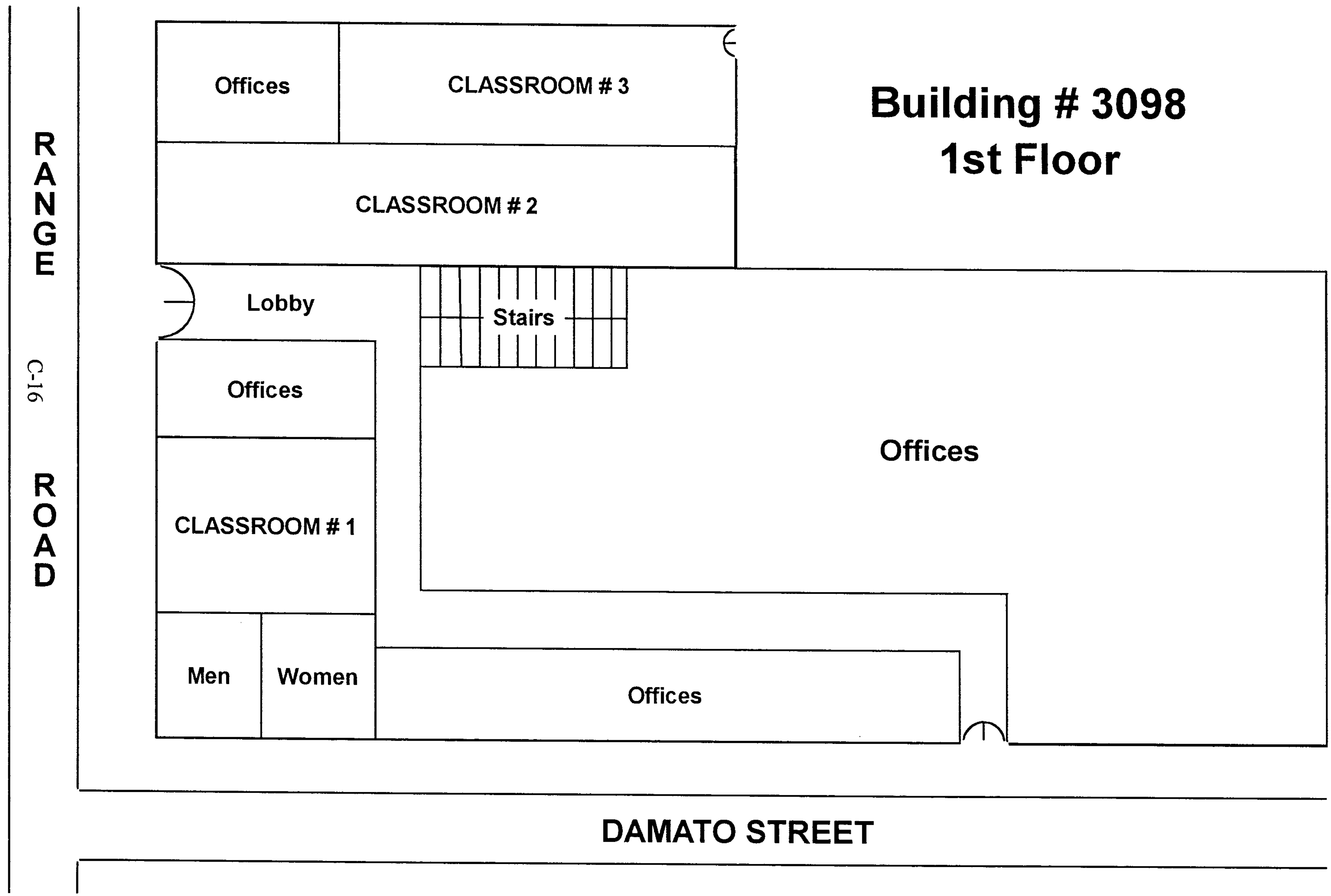
1st Floor



Safety Center
Building # 1001



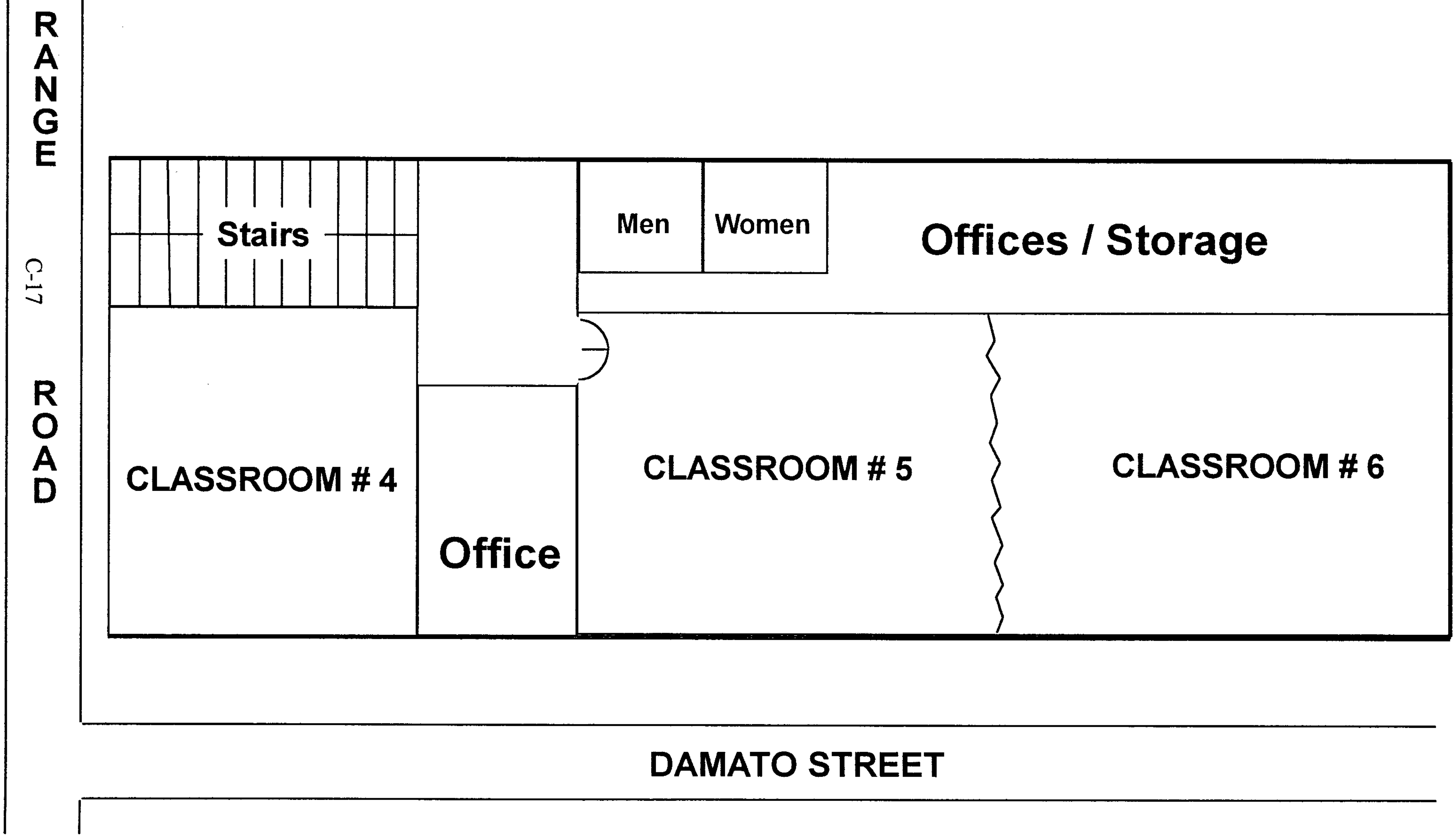
Education Facility -- Diamond Hall



Education Facility -- Diamond Hall

Building # 3098

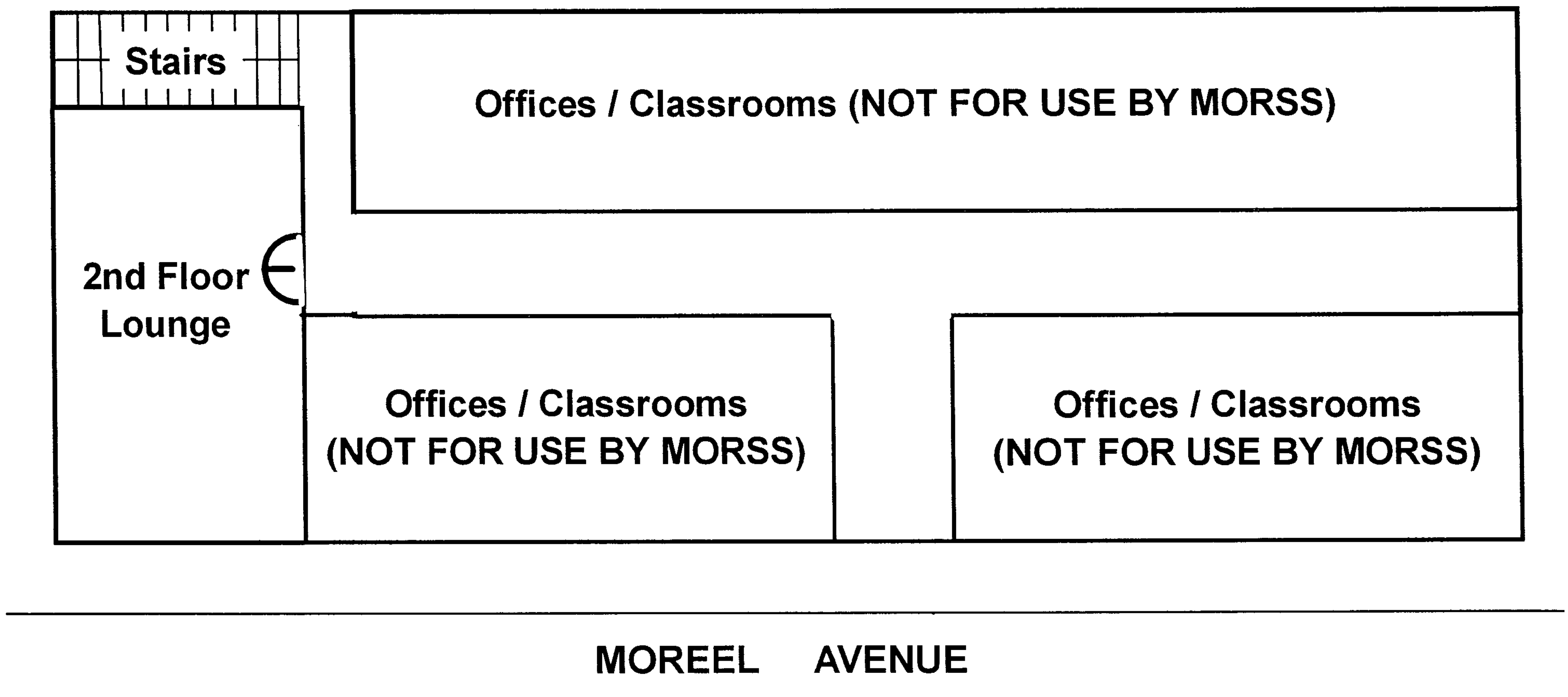
2nd Floor



Command & Control Systems School

Building # 2085

2nd Floor



WG 1 – STRATEGIC OPERATIONS – Agenda
Chair: Mr. Robert V. Gates, NSWCDD
Cochair: Roberta Carlisle, ANSER
Cochair: Maj Scott E. Goehring, USSTRATCOM
Cochair: Capt Jeffrey D. Weir , USSTRATCOM
Advisor: Dr. Gene J. Schroeder, Los Alamos National Laboratory
Room: C&SC – CR-225 and CR-227

Room: C&SC – CR-225

Tuesday, 1030-1200
"Deterrence, Compellence, and Risk(y) Management: Thomas Schelling Meets Joint Vision 2010"
Robert R. Tomes, ANSER

"Strategic Stability Modeling and Analysis"
Wendell B. Nix, Systems Planning and Analysis, Inc.

Discussion Period
Moderator: Ralph Tindal, Systems Planning and Analysis, Inc.

Tuesday, 1330-1500
"Future Strategic Force Structures: Implications for Deterrence and Warfighting"
Major Scott E. Goehring, Kenneth L. Hagerup. and Lynn Langer, USSTRATCOM

"Objective Force Planning (OFP)"
LTC Martemas Arnwine, US Army Concepts Analysis Agency

"xxx in JWARS"
LtCol John O. Yanaros, OSD (Program Analysis and Evaluation)

Wednesday, 0830-1000
"Fuzzy Logic Based Expert System Solutions to Sequencing and Grouping Problems"
Patrick L. Godin, NSWCDD

"FREE - Algorithm for Solution of an SLBM Multiple Constraint Targeting Problem"
Shawna M. Davis and Davis L. Owen, NSWCDD

"A Geographic Information System (GIS) Based Methodology for Developing Future Force Concepts of Operations"
James N. Swan and Robert Piacesi, G&P Associates, Inc.

Wednesday, 1330-1500
COMPOSITE GROUP I SESSION .... MCRC Auditorium

Room: C&SC – CR-227

Wednesday, 1530-1700
"Analysis of Attacks Against Mobile Missile Targets with Hardened Shelters"
Dr. Elisabeth Youmans, John Burton, and Dr. Anthony Kooharian, Systems Planning and Analysis, Inc.

"Modeling MIRV Footprint Constraints for the Weapons Assignment Model"
Major Elliot T. Fair, AFIT Graduate School of Engineering

"Maximizing Target Damage through Optimal Aimpoint Patterning"
Bryan D. Heydon and Stacy D. Hill, Johns Hopkins University/Applied Physics Laboratory

Thursday, 0830-1000: ***"Bugs & Gas!!!!!!": How Do You Kill Them??????? - Part Un***
Session Chair: Dr. Gene J. Schroeder, Los Alamos National Laboratory

"Agent Defeat Weapon Study Overview"
Michael A. Martinez, SA-ALC/NWI

"Mission Analysis Working Group Overview and Progress"
J. Frank Fairchild, ORION International

"Development of the Empirical Lethality Model (ELMs)"
Dr. Patrick J. Griffin, Sandia National Laboratory

Thursday, 1330-1500: ***"Bugs & Gas!!!!!!": How Do You Kill Them??????? - Part Deux***
Session Chair: Dr. Gene J. Schroeder, Los Alamos National Laboratory

"Conventional Weapon Effectiveness in Destroying/Neutralizing Chemical/Biological Agents/Weapons"
Ronald D. Hunt, Wright Laboratory

"Nuclear Weapon Effectiveness in Destroying/Neutralizing Chemical/Biological Agents/Weapons"
John W. St. Ledger, Los Alamos National Laboratory

WG 1 - STRATEGIC OPERATIONS - Abstracts

Tuesday, 1030-1200
"Deterrence, Compellence, and Risk(y) Management: Thomas Schelling Meets Joint Vision 2010"

Robert R. Tomes
ANSER
1215 Jefferson Davis Highway, Suite 800
Arlington, VA 22202

Approved abstract not available at printing.

"Strategic Stability Modeling and Analysis"

Wendell B. Nix
System Planning & Analysis, Inc.
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Alexandria, VA 22311-1712
(703) 578-6313

The Strategic Stability model is a mathematical model designed to evaluate the strategic balance between potential adversaries. The model analyzes the dependence on the size, mix, and vulnerability of strategic forces; mix of offense and defense; and size and distribution of value of the non-strategic targets. The model is based on an analogy to the concept of economic utility. When a strategic weapon is assigned to a value target, there is a payoff of target damage, but there are also costs. Two kinds of costs are defined: opportunity cost (loss of opportunity to use the weapon for other purposes) and strategic cost (loss of ability to deter by destroying a valuable target). Another quantity, "danger," is defined in terms of the payoffs and costs incurred by the two adversaries. The adversaries are motivated to maximize net return (payoff minus costs) and to minimize danger. A striking result is that there is a natural set of conditions for terminating the assignment of weapons to targets; usually well short of the entire arsenal.

The basic ideas and examples of some of the results were presented at the 64th MORS Symposium. We would plan a brief review, but concentrate the presentation on explorations undertaken since then, concentrating on "START III" size strategic forces. This includes the integration of staged counterforce and countervalue attacks. We are currently in the process of integrating strategic defenses into the model and are beginning to get some interesting insights. We also plan to give a status report on this work.

Discussion Period
Moderator: Ralph Tindal, Systems Planning and Analysis, Inc.

Tuesday, 1330-1500
"Future Strategic Force Structures: Implications for Deterrence and Warfighting"

Major Scott E. Goehring, Kenneth L. Hagerup. and Lynn Langer
US Strategic Command/J53
Offutt AFB, NE 68113-5000
(402) 294-4526

This paper presents the findings of a wargame examining the implications of a variety of possible future strategic nuclear force structures. The wargame employed the Arsenal Exchange Model (AEM) and the Fallout Assessment System/Civilian Vulnerability Indicator Code (FAS/CIVIC) models to provide data for analysis. Areas addressed included: available strategic nuclear warheads under various conditions of operational readiness; warheads executed under a variety of attack options; arriving warheads; available and strategic reserve warheads remaining after execution and attrition due to an adversary's attack; and quantitative consequences of execution. The wargame also examined numerous non-quantitative issues involving deterrence, stability, and strategic nuclear warfighting. Finally, the wargame presented the advantages and disadvantages of each of the three possible strategic Dyads should the United States decide to remove one of the three legs of the present strategic nuclear Triad.

"Objective Force Planning (OFP)"

LTC Martemas Arnwine
U.S. Army Concepts Analysis Agency
8120 Woodmont Avenue
Bethesda, MD 20814-2797
(301) 295-1698

Current force requirements are generated from single point scenario estimates. The determination of force requirements in the face of an uncertain, multi-polar world needs to be reexamined in order to account for the wide range of plausible missions U.S. forces may be called upon to execute. The Objective Force Planning (OFP) process, developed to support the Army's deliberations during the Quadrennial Defense Review, seeks to derive Army requirements from a large scenario space. Adapted from a strategy to task framework, OFP identifies plausible Army missions in the 2010 timeframe, and estimates the primary mission forces needed for these missions. It provides an audit trail from the National Military Strategy (NMS) to supporting missions, strategic objectives, tasks, and the forces needed to accomplish these tasks. A key component of the methodology is the use of the Universal Joint Task List (UJTL) which delineates the joint tasks that apply to any mission. The resultant menu of missions and forces is further reduced through Cluster Analysis to generic, composite groupings of missions and associated forces. These composites enable the derivation of Army capabilities necessary to support a given strategy.

OFP is designed to be implemented in a series of workshops. The workshop structure includes a team of controllers, five (5) teams representing each warfighting CINC's area of responsibility (AOR), and an automation team to facilitate data collection. While OFP is primarily focused on Army requirements, the process methodology has great potential for implementation at the joint level.

"xxx in JWARS"

LtCol John O. Yanaros
JWARS Office, AF Representative
Office of the Secretary of Defense (Program Analysis and Evaluation)
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1745 Jefferson Davis Highway
Arlington, VA 22202
(703) 602-2917

The department of defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

This briefing will address JM&SRG requirements, User Group defined scenarios/partitions/use-cases, and associated MOPs / MOEs that will shape the development of JWARS. Potential legacy models and functionalities for reuse will be presented, derived through JWARS workshops and website discussions. The presentation will conclude with a status update on the JWARS program. For Strategic Operations, with respect to 65th MORSS WG interest, initial JWARS work (IOC) focuses on planning and targeting of strategic assets for support of conventional operations, especially in the use and effectiveness of cruise missiles in joint theater operations.

Wednesday, 0830-1000
"Fuzzy Logic Based Expert System Solutions to Sequencing and Grouping Problems"

Patrick L. Godin
Naval Surface Warfare Center, Dahlgren Division
Attn: Code K44, 17320 Dahlgren Road

Dahlgren, VA 22448-5100
(540) 653-8250
Approved abstract not available at printing.

"FREE - Algorithm for Solution of an SLBM Multiple Constraint Targeting Problem"

Shawna M. Davis and Davis L. Owen
Naval Surface Warfare Center, Dahlgren Division
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17320 Dahlgren Road
Dahlgren, VA 22448-5100
(540) 653-8335

Approved abstract not available at printing.

"A Geographic Information System (GIS) Based Methodology for Developing Future Force Concepts of Operations"

James N. Swan and Robert Piacesi
G&P Associates, Inc.
6010 Executive Blvd., Suite 901
Rockville, MD 20852
(301) 984-1580

Approved abstract not available at printing.

Wednesday, 1330-1500
COMPOSITE GROUP I SESSION

Wednesday, 1530-1700
"Analysis of Attacks Against Mobile Missile Targets with Hardened Shelters"

Dr. Elisabeth Youmans, John Burton, and Dr. Anthony Kooharian
System Planning & Analysis, Inc.
2000 N. Beauregard St., Suite 400
Alexandria, VA 22311-1712
(703) 578-5696

Mobile missile transporter, erector and launchers (TELs) survivability depends on covert deployment and movement. They have the capability of rapidly setting up, firing and disassembling, but may be vulnerable to an effective surveillance/reconnaissance system and a rapid-response counterattack.

Our goal is to examine trade-offs involved in attacking these mobile targets. In particular, we will compare the counterbattery capabilities of submarine-launched, surface-launched, and ground-based tactical missiles in the first days of hostilities in a North Korea scenario. The effectiveness of alternative payloads will also be compared.

Our approach uses a Markov multi-state model with physically realistic time behaviors. The model incorporates the mobile missile launcher firing cycle from launch preparation to escaping to a hardened hide site, and the reloading and hiding cycle. It contains elements of mobile target search, targeting, attack, and assessment. The model formulation takes into account the tactical response based on opposing and own force capabilities and their interactions.

The model takes into account command and control delays as well as the ability of each platform to prosecute targets of opportunity. It is our intent to treat this problem on as high a level as possible for overall joint force planning.

"Modeling MIRV Footprint Constraints for the Weapons Assignment Model"

Major Elliot T. Fair
AFIT Graduate School of Engineering
AFIT/ENS
Wright-Patterson AFB, OH 45433-7765
(937) 255-6565

USSTRATCOM is developing a new linear programming model called the Weapons Assignment Model (WAM) to perform weapons assignment for nuclear force structure analyses. One of the major improvements WAM will have over its predecessor is the ability to include MIRV footprinting constraints in the optimization process. In order to include MIRV footprint constraints in WAM, a methodology is needed to model the MIRV footprints in a manner that is consistent with the limitations of linear programming. Two techniques for modeling MIRV footprints were developed. The first, Geometric Approximation (GA), uses a carefully positioned and

sized ellipse on the earth's surface to model the capabilities of a Post Boost Vehicle (PBV) to disperse MIRVs. Any combination of targets within the ellipse is considered to constitute a feasible targeting plan for a missile. The second model is called Energy Space Transformation (EST). This model scales the distance each MIRV is displaced from the missile aimpoint to account for the PBV energy required to maneuver for each MIRV. The sum of the maneuvering energy for each MIRV is used to calculate the fraction of the PBV energy required to strike a particular combination of targets. Any combination where the fraction is less than one is considered feasible. These two models were tested and validated using 120 missile sorties. Both models were approximately 85% accurate.

"Maximizing Target Damage through Optimal Aimpoint Patterning"

Bryan D. Heydon and Stacy D. Hill
The Johns Hopkins University
Applied Physics Laboratory
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Laurel, MD 20723-6099
(301) 953-5000

Approved abstract not available at printing.

Thursday, 0830-1000: ***"Bugs & Gas!!!!!!": How Do You Kill Them??????? - Part Un***
Session Chair:

Dr. Gene J. Schroeder
Los Alamos National Laboratory
PO Box 1663, MS F607
Los Alamos, NM 87545
(505) 665-3101
email: schroeder@lanl.gov

"Agent Defeat Weapon Study Overview"

Michael A. Martinez
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1651 First St. SE
Kirtland AFB, NM 87117-5617
(505) 853-0479
DSN: 263-0479
email: martinez@adw.plk.af.mil

Abstract not available at printing.

"Mission Analysis Working Group Overview and Progress"

J. Frank Fairchild
ORION International
SA-ALC/NWI
1651 First St. SE
Kirtland AFB, NM 87117-5617
(505) 853-0480
DSN: 263-0480 (505) 853-0479
fairchil@nwi.plk.af.mil

Abstract not available at printing.

"Development of the Empirical Lethality Model (ELMs)"

Dr. Patrick J. Griffin
Sandia National Laboratory
Code 9363
PO Box 5800, MS 1146
Albuquerque, NM 87185-1146
(505) 845-9121
email: pjgriff@sandia.gov

Abstract not available at printing.

Thursday, 1330-1500: ***"Bugs & Gas!!!!!!": How Do You Kill Them??????? - Part Deux***
Session Chair: Dr. Gene J. Schroeder, Los Alamos National Laboratory

"Conventional Weapon Effectiveness in Destroying/Neutralizing Chemical/Biological Agents/Weapons"

Ronald D. Hunt
Wright Laboratory/MNSA
101 W. Eglin Blvd., Suite 326
Eglin AFB, FL 32542-6810
(904) 882-4651 Ext. 3316
DSN: 872-4651 Ext. 3316
email: hunt@eglin.af.mil

Abstract not available at printing.

"Nuclear Weapon Effectiveness in Destroying/Neutralizing Chemical/Biological Agents/Weapons"

John W. St. Ledger
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(505) 667-1154
email: stledger@lanl.gov

During the Persian Gulf War the United States and the United Kingdom used the threat of retaliation with nuclear warheads to try and dissuade Iraq from using weapons of mass destruction. Whether or not this was an effective deterrence strategy may be open to debate, but there is no doubt that nuclear weapons could be used to attack weapons of mass destruction. Given that we want to have the option of using nuclear weapons against chemical and biological weapons, how effective would they be? This presentation examines the effectiveness of the nuclear weapons in the United States inventory against biological and chemical agents. Notional targets and agent lethality models are used to show the probability of agent neutralization from a nuclear attack. Possible collateral effects are also examined.

WG 2 – AIR AND MISSILE DEFENSE – Agenda
Chair: Robert Fleitz, Coleman Research Corp.
Co-chairs: Mr. Mike Ellis, Quantum Research Int'l.
Ms. Maggie Enriquez, US Army Air Defense Artillery School
Mr. Fred Jerding, System Planning and Analysis, Inc.
Ms. Sharon Noll, IDA/POET
Mr. Tom Pendergast, Coleman Research Corp.
Ms. Pamela Roberts, US Army Concepts Analysis Agency
Mr. Robert Strider, US Army Space and Strategic Defense Command
Mr. Paul Tabler, S3I
Advisors: Ms. Beverly Nichols, USASSDC
Dr. Charles Infosino, Ballistic Missile Defense Organization
Dr. Dan Willard, ODUSA(OR)
Room: MCRC Auditorium and SNCOA – CR 1

Room: MCRC Auditorium

Tuesday, 1030 - 1200
A Technique for Balancing TMD Interceptor Inventory
Mr. Paul A. Bigelman, Ballistic Missile Defense Organization and Dr. Sean K. Collins, SPARTA Inc.

CorpsSAM/FAAD Synergy Operational Effectiveness Analysis
Mr. John Rybicki, Quantum Research International

Navy TBMD
Mr. Mike Cusack and Mr. Ernie Bubb, SAIC

Tuesday, 1330 - 1500
Tri-Service Attack Operations Study (TSAOS) - Army Analysis
Mr. Phillip W. Jones, TRADOC Analysis Center - WSMR

USAF Attack Operations Analysis
David H. Berg and Gary E. Martin, USAF ACC Studies and Analyses Squadron

Countermobility Concept - An Executive Summary
Dr. Ann Vopatek, BMDO

Wednesday, 0830 - 1000
Airborne Laser Analysis of Alternatives
Major Keith McCready, USAF Studies and Analyses Agency

A Heuristic Approach for Studying the Attack of Mobile Ground Targets
CPT Michael Kent Taylor, USAF Studies and Analyses Agency

Joint Theater Air & Missile Defense Organization (JTAMDO) and the Joint Land Attack Cruise Missile Defense Study
Captain Jacob L. Shuford, Joint Staff (J-8)

Room: SNCOA – CR-1

Wednesday, 1330 - 1500
National Missile Defense Architecture Study
Ms. Nancy Rantowich, Hughes Aircraft Company

Verification, Validation and Accreditation (VV&A) of the National Missile Defense (NMD) Integrated System Test Capability (ISTC) - A Managed Investment Strategy for VV&A Planning for a Hardware-in-the-Loop Test Resource
Robert M. Gravitz, Aegis Research Corp. and Thomas P. Lampton, NMD Program Office

<u>Wednesday, 1530 - 1700</u>
Automating TMD for Training
Gale N. Smith and William G. Tomlinson, Booz•Allen & Hamilton,

New Challenges in Air Defense Systems Analysis
Mr. Stephen Hogue and Mr. Ronald Halahan, US Army Materiel Analysis Activity

Army Air Defense Force Structure Analysis (ADAFSA)-2005
CPT William M. McLagan, US Army Concepts Analysis Agency

<u>Thursday, 0830 - 1000</u>
Bringing Advanced Technology to the Warfighter
Ms. Gladys Reichlen, Deputy Director, DARPA/DISA JPO

Bosnia C2 Augmentation--Innovative Network Solutions for Predator Imagery Dissemination
Mr. Stephen Fabian, MITRE

Bosnia C2 Augmentation--Information Management for The Warfighter
Ms.Eileen Boettcher, MITRE.

<u>Thursday, 1330 - 1500</u>
An Approach to Constructing a Bayesian Probability Distribution for Pk Based on Simulation Modeling and Model Performance Parameter Test Data
Mike Dewitz and Paul Ellner, USAMSAA

An Assessment of the Parametric Endo/Exoatmospheric Lethality Simulation (PEELS) Hit to Kill Prediction Capability Against Theater Ballistic Missiles
John Graham, USAMSAA

Hit-to-Kill Interceptor - Bulk Chemical Payload In Situ Negation
Dr. Martin B. Richardson, Teledyne Brown Engineering

<u>Thursday, 1530 - 1700</u>
Theater Missile Defense System Exerciser (TMDSE)
Mr. Raymond B. Washburn, and Mr. John F. Morash, PEO - Air and Missile Defense

Missile and Air Defense in JWARS
LtCol John O. Yanaros, Jr., JWARS Office, OSD (PA&E)

Lower Tier Interceptor Requirements Study (LOTSA-MSLS)
Mr. Karsten Engelmann, US Army Concepts Analysis Agency

WG 2 - AIR AND MISSILE DEFENSE - Abstracts

<u>Tuesday, 1030 - 1200</u>
A Technique for Balancing TMD Interceptor Inventory

Mr. Paul A. Bigelman,
Ballistic Missile Defense Organization
7100 Defense, Pentagon
Washington, DC 20301-7100

Dr. Sean K. Collins
SPARTA Inc.
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The Department of Defense is again faced with its nemesis, the dichotomy between a growing theater missile threat and a diminishing resource, defense dollars. Always looking for opportunities to save those dollar resources, the expensive theater missile defense systems and, in particular, their inventory of TBM interceptors are likely budget targets. Concerned that US forces have the force structure and interceptor inventory needed, but not more than what's needed, understanding the inventory requirement and ensuring

adequate inventory for each system is a high priority.

This paper describes a methodology that can be used to balance an inventory of interceptors between complementary lower tier systems. Results are shown based upon a determination of total inventory needed to support blue forces in a threat scenario rich in tactical ballistic missiles and an examination of lower tier inventory distributed in varying quantities between lower tier systems. The methodology is partially based upon the Department of Defense's Capabilities Based Munitions Requirements process yet considers the results of force on force modeling in determining the "proper" balance. The methodology can be expanded to account for various additive or subtractive impacts on the threat inventory that the lower tier systems must defend against, such as the introduction of an upper tier or introduction of multiple tier systems.

This methodology was used in Phase II of the Theater Ballistic Missile Defense CAPSTONE Cost and Operational Effectiveness Analysis performed over the past twelve months. It provided information to senior Department of Defense decision makers interested in understanding the inventory relationships between lower tier systems and the impact of the introduction of upper tier and multiple tiered defenses on the lower tier inventory.

CorpsSAM/FAAD Synergy Operational Effectiveness Analysis

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Approved abstract not available at printing.

Navy TBMD

Mr. Mike Cusack and Mr. Ernie Bubb, SAIC

Approved abstract not available at printing.

Tuesday, 1330 - 1500
Tri-Service Attack Operations Study (TSAOS) - Army Analysis

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This study assessed the contribution of Joint attack operations to theater missile defense (TMD) for Phase II of the Ballistic Missile Defense Organization's TMD COEA. The Army TSAOS sponsor was the Deputy Chief of Staff for Operations and Plans, Force Development.

The study timeframe was 2002 and included selected Army, Air Force and Navy assets conducting Joint attack operations in the Northeast Asia (NEA) II - Near Term (1997-2002) Scenario. Threat activities were simulated for D Day through D+6 for both above ground and underground operations. Two levels of advanced warning of hostilities were studied (2 and 22 days of warning) based on the Time Phased Force Deployment List (TPFDL) for two near simultaneous major regional contingencies from the Deep Attack Weapons Mix Study (DAWMS). Additionally, variations in AO tactics, techniques and procedures for Army, Air Force and Navy systems were examined, as were the effects of degraded intelligence, surveillance and reconnaissance (ISR).

The analysis was completed using the Army's Attack Operations Model (AOM) which portrays a threat array containing heavy multiple rocket launchers (MRLs) and mobile short and medium range ballistic missiles and their associated support structure. AOM also includes blue delivery assets, sensor systems, and command, control, communications, computers and intelligence assets necessary to execute Joint attack operations.

Strike assets simulated include F-15E, F/A-18 C/D, AH64-D Longbow and the Multiple Launch Rocket System (MLRS). Both smart and dumb weapons available in the 2002 timeframe were examined. All fixed wing assets had Link 16. ISR assets included the Joint Surveillance Target Attack Reconnaissance System (JSTARS), the Tactical Reconnaissance (TR) 1 aircraft, the TIER II+ unmanned aerial vehicle (UAV), the Defense Support Program (DSP)/Space-Based Infrared (SBIRS) satellites, the Guardrail Common Sensor, the Firefinder Preplanned Product Improved (FFP3I) counterfire radar, and special operations forces (SOF) assets.

USAF Attack Operations Analysis

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Approved abstract not available at printing.

Countermobility Concept - An Executive Summary

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Approved abstract not available at printing.

Wednesday, 0830 - 1000
Airborne Laser Analysis of Alternatives

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The Airborne Laser Analysis of Alternatives (AoA) compared four systems: F-15C with a Kinetic Kill Airborne Interceptor (ABI), Airborne Laser (ABL), Space-based Laser (SBL), and the Advanced Unmanned Aerial Vehicle (UAV) with a Kinetic Kill Interceptor. The AoA was sponsored by the Air Combat Command Directorate of Requirements (ACC/DR), and the analysis was led by Air Force Studies and Analyses Agency Theater Air Defense Branch (AFSAA/SAAT). The primary measure of effectiveness (MOE) examined by the AoA was the number of theater ballistic missiles (TBMs) negated in the boost phase. Additional MOEs included total TBMs killed over the campaign, effective range and coverage, debris shortfall, deployment lift requirements, system availability and the effect of boost phase intercept on the campaign outcome. Each system was examined against both DIA validated vignette days and complete campaigns in three theaters: Northeast Asia (NEA), Southwest Asia North (SWA-N), and Southwest Asia South (SWA-S). Combining the operational effectiveness and system cost led to the most cost effective alternative. The study team also examined excursions which included force structure, reactive threat, cloud height, Intelligence Preparation of the Battlefield (IPB), Probability of Kill (Pk), atmospheric turbulence, magazine size, deployment issues, and attrition. Simulation for the AoA was performed using the Extended Air Defense Simulation (EADSIM) for mission effectiveness, Phillips Lab Airborne Simulation Tempest Revision (PLASTR) for the TBM campaign, THUNDER for the entire campaign, and the Debris Analysis Workstation (DAW) for debris analysis.

A Heuristic Approach for Studying the Attack of Mobile Ground Targets

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In order to assess the operational utility of existing or proposed sensor-to-shooter architectures, most analysts use computer simulations as their primary analysis tool. Most computer simulations, however, lack the functionality and fidelity to adequately model and simulate the complex process of finding and destroying mobile ground targets (although they are useful as visualization tools for asset placement). As simulation programs continue to evolve and better simulate the effects of various systems and model complex processes, the Air Force Studies and Analyses Agency developed a spreadsheet program to analyze timelines associated with attacking mobile ground targets after the target commits an overt act (e.g., TBM launch). Inputs to the spreadsheet program were 3 key parameters: target movement preparation time, target ground speed, and target evacuation distance to "safety." After plotting combinations of the three parameters, analysts compared the resulting timelines against notional Blue Force reaction timelines. These comparisons highlight the feasibility of attacking mobile ground targets and help to provide an analytic basis for understanding the timeline constraints. With an understanding of the timeline constraints, military planners will be better able to define the operational requirements for the systems and architecture necessary to find and destroy mobile ground targets.

Joint Theater Air & Missile Defense Organization (JTAMDO) and the Joint Land Attack Cruise Missile Defense Study
Captain Jacob L. Shuford
Joint Staff (J-8)
Pentagon, Washington, DC

Approved abstract not available at printing.

Wednesday, 1330 - 1500
National Missile Defense Architecture Study

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Approved abstract not available at printing.

Verification, Validation, and Accreditation (VV&A) of the National Missile Defense (NMD) Integrated System Test Capability (ISTC) - A Managed Investment Strategy for VV&A Planning for a Hardware-in-the-Loop Test Resource -

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Approved abstract not available at printing.

Wednesday, 1530 - 1700
Automating TMD for Training

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The Chief of Staff, US Army tasked the Commander US Army Space and Strategic Defense Command (SSDC) to include high fidelity TMD operations in the Battle Command Training Program. As a result the Director of SSDC's Missile Defense Battle Integration Center (MD BIC) initiated efforts last year starting with Prairie Warrior '96 to provide a more realistic representation of TMD operations for both Army and Joint training and mission planning and rehearsals (MPR).

Information age TOC designs identify the need to change the way that simulation occurs. SSDC fielded a Force Projection Tactical Operations Center (FPTOC) in its subordinate command, Army Space Command (ARSPACE), which was to function as the Army Theater Missile Defense Element (ATMDE). This information age TOC has a fully computerized information management system. The command needed a high fidelity training simulation system to stimulate real-world terminals with a view that emulates actual capabilities. This would provide the ability to enhance individual, section, intra- and inter-TOC processes, and makes the command decision process a real-time, measurable activity linked to cause and effect. The need was to be able to conduct precision operations required by TMD.

The initial task required the development of a Distributed Interactive Simulation (DIS) link with Corps Battle Simulation (CBS) to allow the inclusion of high fidelity engineering and analytical models such as the Extended Air Defense Simulation (EADSIM). The decision was made to develop a minimum capability for PW '96 which included a one-way interface between CBS and EADSIM called the Run-Time-Gateway (RTG) that provided threat TBM unit updates and launch information, but continue development of a two-way linkage for the future.

The initial effort envisioned a CBS-DIS-EADSIM linkage to demonstrate technical feasibility and acceptability and the expandability for other high fidelity model inclusion. Two logical outcomes result from this effort. The first is that both CBS and the JTC continue to provide users with the degree of stimulation desired. The FPTOC's and other information age TOCs' needs differ from those of conventional "map board, grease pencil and sticker" TOCs. The former requires an electronic stimulation while the latter needs records

and reports to display current information. In the TMD context or any time during critical target operations, electronic stimulation provides the timeliness desired and required for effective decisions and execution. The high fidelity look at the TMD problem set provides the analytical perspective previously lacking in CBS or JTC models or engineering and analytical models in use today. This briefing will also address current changes being made to CBS, the RTG and EADSIM so that from an operational standpoint EADSIM will simulate the firing and attrition adjudication of all high altitude and medium altitude (HIMAD and ALLRAD) radar aimed and Air Defense Artillery (ADA) against fixed wing aircraft, cruise missiles, and tactical ballistic missiles with a two-way link to CBS.

New Challenges in Air Defense Systems Analysis

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The air defense mission has been enlarged in recent times to include defense against Tactical Ballistic Missiles (TBM). This mission brings new challenges to the analysis community. Modern radars for TBM defense, such as those used by THAAD and Patriot, are developing the flexibility to maximize system performance by choosing specific surveillance parameters for each deployment site and for the specific threats to defended areas around that site. Old Measures of Performance, such as the detection range against specific targets, lose their meaning. Detection performance is still a function of the target's signature characteristics, but the frame rate for surveillance volume search, the type of signal the radar will use in its search, and the percent of available energy used in each volume are all functions of the threat, the requirements of the specific threat, interceptor performance, and the desired fire doctrine. Systems analysts attempting to make assessments concerning the performance of various systems against TBMs on new battlefields must have a method to estimate the surveillance performance of the radars under consideration. This paper will highlight a methodology developed at the Army Material Systems Analysis Activity which performs the needed tradeoffs to determine surveillance performance. Examples of the sensitivity of surveillance performance to changes in threats, site requirements and interceptor performance will be discussed along with the methodology.

Army Air Defense Force Structure Analysis (ADAFSA)-2005

Captain William M. McLagan
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This analysis addresses the US Army's Corps and Echelon Above Corps (EAC) air defense force structure required for the 2005 timeframe. The analysis determines the number of Patriot and Theater High Altitude Area Defense (THAAD) firing batteries needed to protect each of the CINC's defended asset priorities consistent with the Defense Planning Guidance (DPG) 1998-2003. The number of Patriot and THAAD firing batteries is shown using a doctrinal level of protection and again using an optional level of protection available to the CINC if a reduced number of air defense units is available to defend these assets. This number of firing batteries constitutes the Army's Corps and EAC threat-based air defense force structure requirement. This analysis further shows the risks associated with each level of protection, including the number of threat TBMs expected to hit friendly assets, the effects of these TBMs against an airfield, and the effects on the overall theater campaign. These effects are shown based on previous analysis conducted within CAA and other independent agencies. The contribution of air defense support provided by the US Air Force and the US Navy are also shown. Finally, this analysis shows the Army's air defense force structure requirements to maintain the training base and a strategic reserve. This analysis was originally requested by the Deputy Chief of Staff for Operations (DCSOPS), Office for Air and Missile Defense, Headquarters, Department of the Army, for the Total Army Analysis (TAA)-2005 process conducted within HQDA. The briefing was presented to the Assistant Deputy Chief of Staff for Operations (ADSCOPS) for Force Strategy on 7 January 1997.

<u>Thursday, 0830 - 1000</u>
Bringing Advanced Technology to the Warfighter
Ms. Gladys Reichlen, Deputy Director, DARPA/DISA JPO

Bosnia C2 Augmentation--Innovative Network Solutions for Predator Imagery Dissemination
Mr. Stephen Fabian, MITRE

Bosnia C2 Augmentation--Information Management for The Warfighter
Ms.Eileen Boettcher, MITRE.

Approved abstracts not available at printing.

Thursday, 1330 - 1500

An Approach to Constructing a Bayesian Probability Distribution for Pk Based on Simulation Modeling and Model Performance Parameter Test Data

Michael B. Dewitz and Paul M. Ellner
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Throughout the Army missile system acquisition process, estimates of true performance are compared to required performance (expressed by probability of kill (Pk)) as a means of determining whether a program should continue. Because true system performance is unknown, equally important equally important as the estimate of true performance is a measure of assurance that the true performance exceeds the requirement. When the data used to develop the estimates of system performance come from system level testing of actual hardware, that assurance is often expressed in terms of confidence bounds using classical statistical analysis techniques. Funding available for testing Army missile systems is decreasing. Many programs are conducting more component and subsystem testing to quantify the performance parameters that define overall system performance and then executing complex simulations to relate these performance parameters to Pk. This presents the challenge of determining a suitable, quantifiable measure of assurance that true system performance exceeds the requirement when data come from simulations and a wide variety of test sources.

AMSAA has developed methodology based on Bayesian analysis that quantifies the probability of belief associated with output from a simulation model. The approach is to quantify the distribution of uncertainty in the input parameters to the simulation model based on available test data. This uncertainty is used to generate a distribution of belief regarding the outcome of the simulation model. The generated belief distribution gives the Bayesian probability that a specified level of performance has been achieved. This paper describes the methodology developed by AMSAA and discusses an example that demonstrates the applicability of the methodology.

An Assessment of the Parametric Endo/Exoatmospheric Lethality Simulation (PEELS) Hit to Kill Prediction Capability Against Theater Ballistic Missiles

Mr. Johnny L. Graham
USAMSAA
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As part of the PEELS accreditation process (for use in the Theater High Altitude Area Defense milestone II phase), AMSAA and the PEELS accreditation working group conducted analysis of the PEELS database. This analysis focused primarily upon comparisons of PEELS predictions, test results, and other simulation predictions. These comparative analyses consisted of four phases: comparison of PEELS predictions with sled test results, comparisons of PEELS predictions with hydrocode predictions, a comparison of PEELS prediction with a flight test, and a comparison analysis of closing velocity percent occurrence for THAAD/threat intercepts with the closing velocity range for the PEELS database.

Since the measurement of engagement parameters for hit to kill sled tests (and flight tests) is not accomplished with 100 percent certainty (there exists a degree of inherent uncertainty), comparing simulation predictions with results of sled tests requires consideration of these uncertainties. These uncertainties are attributable to the precision of the measurement instrumentation (instrumentation tolerances). The resulting measurement uncertainties can significantly affect results of simulations when trying to duplicate results from sled tests. Thus, a PEELS sensitivity analysis was conducted to examine the effects of measurement uncertainties on PEELS prediction results.

This paper describes the measures of effectiveness and methodologies used to perform all the above analyses and the results of these analyses (when measurement uncertainties are considered and when the measurement uncertainties are disregarded).

Hit-to-Kill Interceptor - Bulk Chemical Payload In Situ Negation

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Ensuring the defeat of a TBM bulk chemical payload involves more than simply rupturing the tank -- it also involves negation of the payload so that no more than a benign concentration ever makes it to the ground. It has been shown through sub-scale gun tests, full-scale sled tests, and flight tests that a bulk chemical payload tank is relatively easy to rupture with a hit-to-kill (HTK) interceptor. However, the response of the bulk payload fluid to the mechanical "insult" is not so clear. Unlike explosions in "infinite" or "semi-infinite" fluids (e.g., underwater explosions), where periodic and longer-term phenomena can manifest themselves, the timescale of a HTK event lasts only on the order of milliseconds before the high pressures and temperatures generated by the engagement rupture the payload

tank and the fluid is expelled into the surrounding space. While the energy generated in the impact can easily be in the hundreds of megajoules, the processes that couple that energy into the fluid are not sufficiently understood. Knowledge of these processes are required to predict the rate of fluid expulsion, aerosolization, vaporization, and potential chemical changes which determine the source term required for input in transport and diffusion codes for ground effects predictions.

This paper examines energy considerations for intercepts of a HTK projectile with a bulk chemical payload. Various physical and chemical processes are discussed relative to their energy requirements and timescales. Relevant sub-scale and full-scale test results against TMD targets will be included. A better understanding of the physical processes that could be involved will provide for: 1) a rational approach to further lab-scale phenomenology testing, 2) a more intelligent choice of instruments for gathering lethality data, and 3) insight into the results of sophisticated numerical models.

Thursday, 1530 - 1700
Theater Missile Defense System Exerciser (TMDSE)

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The Theater Missile Defense System Exerciser (TMDSE) is being developed by the US Army Program Executive Office for Air and Missile Defense under the direction of the Ballistic Missile Defense Organization (BMDO/AQT).

The TMDSE is a computer-based test tool that provides the capability to progressively integrate TMD weapon and sensor systems and evaluate the overall TMD system-level operational performance. In real-time, the TMDSE injects a controlled, simulated threat into real, geographically distributed TMD tactical sensors and weapon systems to provide a hardware-in-the-loop test capability. The TMDSE stimulates each tactical weapon system with a realistic threat scenario including TBMs, air breathers, weather, and terrain. The tactical systems respond to these threat stimuli and communicate via their respective tactical communications data nets allowing each individual TMD component system to operate in concert as part of a synergistic theater missile defense architecture.

The TMDSE Build 1 was a joint program that included: the Army PATRIOT and JTAGS systems; the Navy AEGIS weapon system; and the Air Force SHIELD and sensor systems. The next planned release of TMDSE (Build 2) will include the Army THAAD missile system and the Marine Corps TBMD HAWK missile system.

The TMDSE is an integral part of BMDO's overall test and evaluation strategy that supports the successful acquisition of the TMD family of systems (FoS). The strengths of the TMDSE include its design flexibility that facilitates the incorporation of new tactical weapon system elements by easily interfacing these elements into the distributed, real-time TMDSE network.

Missile and Air Defense in JWARS

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The Department of Defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

This briefing will address JM&SRG requirements, User Group defined scenarios/partitions/use-cases, and associated MOPs / MOEs that will shape the development of JWARS. Potential legacy models and functionalities for reuse will be presented, derived through JWARS workshops and website discussions. The presentation will conclude with a status update on the JWARS program. For Missile and Air Defense, with respect to 65th MORSS WG interest, JWARS will include a balanced design of all service theater missile and air defenses, to include multi-tiered defenses and functionalities including supporting sensors (air, land, sea and space based, including national technical means) and battle management (planning and tasking) elements of a CINC or JTF.

Lower Tier Interceptor Requirements (LOTSA-MSLS)

Mr. Karsten Engelmann
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The Lower Tier Interceptor Requirements (LOTSA-MSLS) Quick Reaction Analysis (QRA) was initiated by the US Army Concepts Analysis Agency in the Spring of 1996 at the request of the US Army Space and Strategic Defense Command (SSDC). LOTSA-MSLS applied several different methodologies to answer the question, what are the effects of different lower tier inventories/types on the Theater Missile Defense (TMD) campaign? A secondary but closely related question of how much risk is associated with various inventories was also asked.

Three modeling methodologies are examined. All of the methodologies are designed for quick turnaround of the question asked. First, a back-of-the-envelope analysis of the problem was considered. Then a spreadsheet model was created to answer the question presented. Finally, an optimization model was created using the Mathmatica language that evaluated both inventory levels as well as risk associated with different lower-tier interceptor contributions.

WG 3 – Arms Control and Proliferation – Agenda
Chair: Ms. Karen Ann Stark, BDM Federal, Inc.
Cochair: Major Joe Hogler, USSTRATCOM
Advisor: Dr. Robert Batcher, Arms Control and Disarmament Agency
Room: C&SC – CR 102, CR 216 and CR 146

Room: C&SC – CR-102

Tuesday, 1030-1200
Chaos and Catastrophe Theory Applications to Arms Control
William Scanlan and Larry Wolfarth, TASC, Inc.

Uncertainties in Ballistic Missile Defense Performance: Implications for Strategy
Dr. James Scouras, Strategy Research Group

Fundamentals of the Strategic Offense-Defense Relationship
Dr. Robert T. Batcher, U.S. Arms Control and Disarmament Agency

Tuesday, 1330-1500
Multi-Lateral Arms Control: A Framework for Analysis
Ron Crutchfield and Joan Sanborn, Lockheed Martin Missiles & Space

Third Party Threats in a Multi-Polar World
Kyle B. Olsen, TASC, Inc.

Wednesday, 0830-1000
The Determinants of Domestic Arms Production in Third World Countries
Mark L. Padgett, PhD., Dept. of Military and Political Science, Duke University

Mapping a Labyrinth: A Working Model of Service Counterproliferation Activities
Georganne Thibault and Robert R. Tomes, ANSER

Aspects of Russian-American Stability Issues with Reduced Strategic Forces
Dr. Frederic S. Nyland, Consultant, U.S. Arms Control and Disarmament Agency

Wednesday, 1330-1500
COMPOSITE GROUP I SESSION .... MCRC Auditorium

Room: C&SC – CR-216

Wednesday, 1530-1700
Conventional Armed Forces in Europe (CFE): Treaty Elements, Adaptation Issues and Analytical Questions
Dorn Crawford, U.S. Arms Control and Disarmament Agency

Aspects of the Freedom to Mix Concept
Dr. Frederic S. Nyland, Consultant, U.S. Arms Control and Disarmament Agency

Room: C&SC – CR-146

Thursday, 0830-1000
Whither Arms Control: A Panel Discussion
Dr. Brad Roberts, Institute for Defense Analyses; Ms. Mary Margaret Evans, Office of the Secretary of Defense; Dr. Edward Lacey, U.S. Arms Control and Disarmament Agency

Thursday, 1330-1500
Arms Control Technologies for the IAEA
Karl Horak, Ogden Environmental

Evaluation of Personnel, Equipment and Procedures for Verifying State Party Compliance with the CWC
Jean Razulis, USA CBDCOM

WG3 - ARMS CONTROL AND PROLIFERATION - Abstracts

Tuesday, 1030-1200

Chaos and Catastrophe Theory Applications to Arms Control

William Scanlan and Larry Wolfarth, TASC, Inc.

Approved Abstract Not Available at Printing

Uncertainties in Ballistic Missile Defense Performance: Implications for Strategy

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This study addresses the relationship between uncertainty and the effectiveness of ballistic missile defenses from two perspectives: the random effects of offensive leakage through defenses and incomplete knowledge of leakage. Implications of these uncertainties for both attacker and defender are analyzed.

The study draws the following conclusions. First, analyses only taking into account expected value calculations without also including uncertainty can provide misleading results. Second, whichever side attempts to achieve high confidence in an offense/defense engagement will have to pay a high price to do so. In particular, high-confidence limited attack options may not be feasible in the face of ballistic missile defenses unless the defenses can be either overwhelmed or circumvented. In addition, defenses capable of providing high confidence protection against limited attacks would probably undermine the effectiveness of deterrence based on offensive retaliation.

Fundamentals of the Strategic Offense-Defense Relationship

Dr. Robert T. Batcher,
U.S. Arms Control and Disarmament Agency
320 21st St. NW, Room 5726
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A major concern in strategic arms control is the relationship between offenses and defenses. The Anti-Ballistic Missile Treaty between the United States and Russia limits the size, composition and basing of both countries' Ballistic Missile Defense systems. Such limited systems are generally not considered to have a major impact on offensive strategic arms control. The Ballistic Missile Defense Organization is actively researching National Missile Defense systems. Although these systems are intended to comply with the ABM Treaty, Russia is concerned they will grow both technically and numerically to the point where they do not comply with the treaty, offsetting the balance established through offensive strategic arms control.

It is important that we understand the relationship between strategic offenses and defenses. Such an understanding has been difficult to achieve both technically, because of complexity, and emotionally, because of opposing "camps" of advocacy within the United States. This paper explores the fundamental basis of the relationship between offenses and defenses by representing them as simplified theoretical constructs in a setting that allows analysis of a continuum of offense structures that trade off between offenses and defenses. Simplifying the analysis to consider an idealized case with one type of offensive weapon allows the derivation of underlying equilibrium results. Selectively adding elements of additional realism and exploring the resultant impact on the equilibrium results leads to a richer understanding of the basic relationship between offenses and defenses.

Tuesday, 1330-1500

Multi-Lateral Arms Control: A Framework for Analysis

Ron Crutchfield and Joan Sanborn, Lockheed Martin Missiles & Space
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Whether or not the US and Russia move beyond Start I, at some point early in the next century, probably within the next decade, accommodations between those countries possessing nuclear weapons, as well as those wishing to possess them will have to be addressed.

Geopolitical and geostrategic realities, brought on by political and economic forces already in motion before the end of the Cold War, make it certain that several countries will make decisions on the possession of nuclear weapons and the sizes of arsenals within the near future. The U.S. will find it necessary to take these decisions into account, influencing them if possible, either by formal agreements or by tacit understandings. This paper is an attempt to sketch out the kinds of nuclear arms control agreements which may be feasible under various circumstances, and to derive the impacts, if any, on the Fleet Ballistic Missile programs.

Third Party Threats in a Multi-Polar World

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In the years since the Gulf War, the arguments have been made that chemical and biological weapons (CBW) should not be viewed as equivalent to nuclear weapons, and that modern conventional capabilities are a very effective counterbalance. But what happens in the event of a successful CBW attack against a nuclear power which does not enjoy the American luxury of overwhelming conventional forces? The potential user of CBW in this context poses dramatic, unanswered security questions for the United States.

Following a moderately effective CBW attack (10-50,000 fatalities), any foreign government would be under tremendous pressure to respond with maximum force, the goal being to inflict disproportionately heavy casualties on the attacker. For a wounded nation's people and leaders, nuclear retaliation could be justified militarily, politically and even morally.

Depending on the scenario and the involved parties, Washington political and military leaders would be forced to choose among several equally unattractive responses, each with profound political and military consequences:

1. Diplomatic intervention, in a probably ineffective effort to reach a peaceful resolution.
2. Military assistance/intervention, lending US conventional forces to a punitive action against the aggressor as a hedge against a nuclear response.
3. Unilateral US "police action."
4. Hands off, essentially sanctioning a nuclear response.

There is a clear need to reassess the potential threat of CBW from other than the America-centric perspective that naturally occupies US defense planners. The potential domino effects of WMD use against a nuclear or near-nuclear state represents a significant, unstudied element in the international security equation.

Wednesday, 0830-1000

The Determinants of Domestic Arms Production in Third World Countries

Mark L. Padgett, PhD., Dept. of Military and Political Science, Duke University

Approved Abstract Not Available at Printing

Mapping a Labyrinth: A Working Model of Service Counterproliferation Activities

Georganne Thibault and Robert R. Tomes, ANSER

Approved Abstract Not Available at Printing

Aspects of Russian-American Stability Issues With Reduced Strategic Forces

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This paper provides an examination of three possible sets of strategic nuclear force structures beyond START II that might set terms for future arms reduction treaties between the U.S. and Russia. Warhead limits of 2500 (proposed START III), 1500, and 800 are evaluated in terms of their possible stability problems. The measures used in this analysis include first strike stability with and without national ballistic missile defense, and one indicator of geopolitical stability. Assumed force structures and postures illustrate general methods of analyzing the impacts of reductions in strategic nuclear arsenals.

Wednesday, 1330-1500

COMPOSITE GROUP I SESSION

Wednesday, 1530-1700

Conventional Armed Forces in Europe (CFE): Treaty Elements, Adaptation Issues and Analytical Questions

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Since the signing of the CFE Treaty in November 1990, the transformation of European security it embodies has proceeded apace, although certainly not without lingering difficulties and challenges. The 34 nations convened there under the auspices of the Conference on Security and Cooperation in Europe, or CSCE, are now 52; the 22 original parties to the CFE Treaty, signatories of either the erstwhile Treaty of Warsaw or the North Atlantic Treaty, are now 30. The unprecedented reduction of conventional armaments in the region has been largely completed. CSCE is now the Organization on Security and Cooperation in Europe, or OSCE.

The CFE Treaty itself is a highly complex undertaking of twenty-three articles and associated protocols, with the full English text running to some 110 pages. Associated reports, notifications, and information exchanges to date already yield ample new metaphors for our concept of an 'information explosion'. This overview is a self-conscious effort to distill and simplify the central aspects of the Treaty and associated documents, focusing on aggregate equipment and manpower limits, holdings, liabilities and sites. With Treaty adaptation under active discussion, and the enlargement of NATO a closely related prospect, analytical questions of the resulting 'balance' and 'military sufficiency' have returned in far more complicated forms.

The analytical task this effort represents is a familiar one: seeking adequate measures of effectiveness that economically convey the main thrust of the phenomena observed, and then using them for analytical tasks. Trading off simplicity against precision, concept against comprehensiveness, are at the heart of scientific inquiry, and adequate oversight of a major arms limitation treaty should certainly meet that standard. Reviewing and discussing means and measures employed in this pursuit should thus be of interest to analysts as well as policy makers.

The evident premise of this work remains the old but still operative bromide that holds a picture to be worth a thousand words. The object is to use a handful of graphics and accompanying narrative on the key features of the CFE regime as a vehicle to inform discussion of issues of continuing interest as Treaty implementation is concluded and long-term adaptation begins.

Aspects of the Freedom to Mix Concept

Dr. Frederic S. Nyland, Consultant
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This paper presents an examination of the Freedom to Mix Concept where strategic offensive nuclear weapons may be reduced in exchange for the deployment of national anti-ballistic missile defenses (ABM). The results of the analyses are presented in terms of first strike stability and damage limitation trends for reductions in ICBMs, bombers, and SLBMs. It is assumed that for each offensive warhead eliminated, two defensive interceptors may be deployed.

First strike stability between the U.S. and Russia can be seriously degraded by increases in the extent of ABM defenses (up to 1200 interceptors) deployed by both sides. The use of decoys accompanying attacking or retaliating RVs lessens degradations in first strike stability.

Preserving first strike stability and perfecting damage limitation capabilities are conflicting goals. Limiting damage tends to undermine first strike stability. Either side could be tempted to strike first in the belief that the damage from retaliatory attacks can be lessened by effective ABM defenses.

Under certain conditions, first strike stability may not be degraded where the U.S. deploys an extensive ABM system, but Russia does not. This result depends critically on the assumption that Russia is able to develop and employ credible decoys to spoil the effectiveness of a U.S. ABM system.

Thursday, 0830-1000

Whither Arms Control: A Panel Discussion

Discussants: Brad Roberts, Institute for Defense Analyses; Mary Margaret Evans, Office of the Secretary of Defense; Dr. Edward Lacey, Arms Control and Disarmament Agency;

Thursday, 1330-1500

Arms Control Technologies at the IAEA

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One of the most rapidly advancing areas of computer technology is the Internet. Its impact has spread from DARPA's originally dry technical fare to increasingly sophisticated and widespread information. As more information becomes available on the World Wide Web, it has become an important open source of arms control and non-proliferation information.

The International Atomic Energy Agency (IAEA) has embraced Web technologies both for internal use and for public dissemination of information. As would be expected, different tools are being used by the various groups based on their functional requirements. This paper reviews the status of Web technologies at the UN Special Commission 687 Action Team, in Safeguards Information Technologies (SGIT), in the three Operations groups, and on the agencies own home page.

The Action Team uses stand-alone computers for Internet access with an air gap between the external network and their secure LAN. Web user is limited to non-sensitive e-mail, external Web research with commercial tools, and developmental prototypes on their internal Web. New products are being explored for sharing data across a small intranet. SGIT is testing commercial and proprietary systems for processing in-house and open-source data. Prototype analyst workstations are installed and a variety of tools are being evaluated. Operations have been exploring the user of Adobe PDF files for intranet dissemination of information. The IAEA maintains its own home page but only portions are available to the public.

Evaluation of Personnel, Equipment and Procedures for Verifying State Party Compliance with the CWC

Jean Razulis, USA CBDCOM

Approved Abstract Not Available at Printing

WG 4 — REVOLUTION IN MILITARY AFFAIRS — Agenda
Chair: Mr. Michael G. Miller, Aegis Research Corporation
Co-Chairs: Mr. Frank Paparozzi, ANSER Corporation;
Mr. Edmund M. Glabus, Aegis Research Corporation
Advisors: Mr. Bill Swart, Joint Command and Control Warfare Center
Dr. Thomas Welch, Office of the Secretary of Defense
Room: C&SC – CR 140 and CR 103

Room: C&SC – CR-140

Tuesday, 1030-1200
The Revolution in Military Affairs - Can the U.S. Prepare for the Next Peer Competitor?
Messrs. Alan Goldman and Gerald Halbert, National Ground Intelligence Center, Department of the Army

Tuesday, 1330-1500
The Revolution in Military Affairs *- The Logistics Anchor Desk - Supporting the CINC's Campaign Plan.*
Mr. Hugh M. Denny and Ms. Patricia Jones

Wednesday, 0830-1000
The Revolution in Military Affairs - Alternate Futures for 2025
Lt Col Robert L. Bivins, USAF and Major Kevin C. Smith, USAF, Air War College

Wednesday, 1330-1500
COMPOSITE GROUP I SESSION .... MCRC Auditorium

Room: C&SC – CR-103

Wednesday, 1530-1700
The Revolution in Military Affairs - The Navy in 2020
Captain Edward Smith, USN, CNO Executive Panel

Thursday, 0830-1000
The Revolution in Military Affairs - Concept for Future Joint Operations
Lt Col Ed Felker, USA, Joint Warfighting Center

Thursday, 1330-1500
The Revolution in Military Affairs - The Army After Next
Professor Doug Johnson, US Army War College

Thursday, 1530-1700
The Revolution in Military Affairs - Information Warfare and Force Structure
Messrs. Joseph J. Helman and David H. Dunham, TASC, Inc.

WG 4 — THE REVOLUTION IN MILITARY AFFAIRS — Abstracts

Tuesday, 1030-1200
The Revolution in Military Affairs - Can the US Prepare for the Next Peer Competitor?

Messrs. Gerald A. Halbert and Dan Goldman
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The term peer, by common definition, implies an equal or equivalent entity. It is unlikely that any foreign power or entity can attain the technological prowess, military budget, training experience or power projection capabilities of the US over the next two decades.

Yet this paper will argue that US political and military leaders might well miss the indicators of an emerging regional competitor, and thereby find themselves surprised and defeated by a major regional foreign power. The victorious power will be quickly and widely recognized not only as a superior regional power, but also as a strategic peer competitor with the ability to severely diminish the global prestige, alliances and influences of the US. The greatest strategic challenge for the US in the last 80 years has been to prevent the domination by any power in Eurasia, as this could constitute a threat to US vital interests. Economic and demographic trends, history, political motivation, and local opportunity suggest that China will emerge as a peer rival of the US in Asia, probably by 2010. Should China choose to wage asymetrical warfare by exploiting US vulnerabilities and take advantage of local geographic, demographic, and military circumstances, it could demonstrate to the world that the US has met its match. Through the medium of a scenario, this paper will show how the US may find itself confronted by a peer competitor whose emergence should have been obvious, but which, tragically, catches us by surprise.

Tuesday, 1530-1700
The Revolution in Military Affairs - The Revolution in Military Affairs *- The Logistics Anchor Desk - Supporting the CINC's Campaign Plan*

Mr. Hugh M. Denny and Ms. Patricia Jones
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This paper will address the technical and functional aspects of an OSD-sponsored project that applies artificial intelligence (AI) technology to address the military logistics functions that are crucial to successful battle commanders. The technology deliverable of this program is called the Logistics Anchor Desk. The Logistics Anchor Desk is a prototype logistics operations cell where current logistics information is a readily available and powerful analytical tool and simulations provide the capability to examine the CINC war fighting sustainment issues.

Wednesday, 0830-1000
The Revolution in Military Affairs - Alternate Futures for 2025

Lt Col Robert L. Bivins, USAF
Major Kevin C. Smith USAF
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Preparing for the future is as much an art as it is a science. The AF 2025 study contributes to the exercise of that art by systematically employing the Alternate Futures process in the creative environment of a futures study. This presentation delineates the Alternate Futures process which bounded the operating environments of 2025 in which various proposed systems, concepts and technologies were evaluated. To envision the world of 2025, the study had to make predictions. Futurists use several methods to "forecast" the future. The approach used for the AF 2025 study creates alternate futures by examining trends, studying the work of respected futurists, considering surprises and "wild cards," and conducting analyses to identify the factors or "drivers" that will be major contributors to change. After extensive analysis, the Alternate Futures team identified six alternative futures to form the foundation of the AF 2025 study. The importance of long-range planning has never been greater due to the dwindling resources dedicated to defense, debates over roles and missions, and the changing security environment. In response to this need the Air Force embarked on a wide-ranging effort to improve long-range planning. The Air University hosted AF 2025 study looks 30 years into the future and identifies the systems, concepts of operation and technologies required to ensure the US possesses the dominant air and space forces of the future.

Wednesday, 1330-1500
COMPOSITE GROUP I SESSION

Wednesday, 1530-1700
The Revolution in Military Affairs - The Navy in 2020

Captain Edward Smith, USN
CNO Executive Panel
The Pentagon
Washington, DC

Approved abstract not available at printing

Thursday, 0830-1000
The Revolution in Military Affairs - Concept for Future Joint Operations

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Approved abstract not available at printing.

Thursday, 1330-1500
The Revolution in Military Affairs - The Army After Next

Professor Doug Johnson
US Army War College
Carlisle, PA

Approved abstract not available at printing

Thursday, 1530-1700
The Revolution in Military Affairs - Information Warfare and Force Structure

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Traditional methods of warfare are being supplemented by technology-based warfare, including what has become known as Information Warfare (IW). An attack on an adversary's vital national resources is no longer limited to the overt physical destruction of those resources. Substantial and potentially devastating damage can be inflicted without crossing the threshold of violence or even physically crossing international borders. Some proponents posit that IW could reduce the likelihood of armed conflict since adversaries could be deterred by an IW threat to their vital interests. Should deterrence fail and armed conflict occur, IW could also contribute to achieving a rapid, decisive outcome, thereby lowering the material and human costs of war. In an era of declining budget resources, some would argue that a robust IW capability would facilitate reductions in force structures in exchange for lower cost, less violent IW capabilities. This argument assumes that the threat of IW is as persuasive, and can achieve similar political and military results as other weapons--a proposition that has yet to be systematically examined. This study addresses this proposition via the following research questions: Can IW contribute to US deterrent posture? What lessons can we learn from the evolution of nuclear deterrence when compared to IW?

WG5A - EXPEDTIONARY WARFARE
WG5B - POWER PROJECTION ASHORE
Chair: CDR "Boots" Barnes, OPNAV/N815
Co-Chair: Mr. Tim Sullivan, Texas Instrument
Co-Chair: Capt Kevin Brown, USMC, MCCDC
Advisor: Col(retired) Ted Smyth
Rooms: WG5A - Diamond Hall – CR-4
WG5B - Diamond Hall – CR-5

WG5A - EXPEDTIONARY WARFARE

Tuesday, 1030-1200
COMPOSITE GROUP II SESSION..Ellis Hall

Diamond Hall – CR-4

Tuesday 1330-1500
Urban Warfare (URBAN WARRIOR)
Capt Kevin Brown, MCCDC, Studies and Analysis

Marine Corps Ammo Requirements
Capt Don Bates, Operations Analyst, MCCDC

*Wednesday 0830-1000 - **MCM & AMPHIB LANDINGS***
In-Stride Breaching for and Amphibious Assault
Dr. Rudolf Wiley, GS-13, Research Scientist, NSWC, Dahlgren

Autonomous Legged Underwater Vehicles
CAPT Edwin Middlebrook, Professor Bard Mansager, Navy Postgraduate School

Wednesday 1330-1500 - AMPHIB OPERATIONS
ADC(X) in Support of Amphibious Operations
Dr. Jack Ince, Center for Naval Analyses

Over the Horizon Amphibious Assault and Maneuver with the AAAV
MAJ Greg Dyekman, CPT Mark Blackburn, Combat Operations Analyst, TRADOC

Wednesday 1530-1700 - AMPHIB OPERATIONS
Comparing Alternative 2015 Force Structures Re Amphibious Lift and Landing
Mr. Fritz Brink, NSWC, Dahlgren

ISR Simulation for Expeditionary Operations
Mr. Rich Munro, Senior Analyst, N81/SAIC

Thursday 0830-1000 - Ground Warfare
Ground Warfare Modeling
Dr. Andy Ilachinski, Center for Naval Analyses

Expeditionary Warfare Threat Environment Projections
Ms. Judy Hance/Mr. Benjamin Wong, Intelligence Specialist, Marine Corps Intelligence Specialist

Thursday 1330-1500 - Ground Warfare/SOF
Joint Anti-Armor Item Level Performance Analysis
Mr. Ron Thompson, Mr. Lee Blankenbiller, AMSAA, Aberdeen Proving Ground

High Resolution Modeling of Naval Special Warfare VSW/MCM Operations
LCDR Robert Wilson, Professor Bard Mansager, Naval Postgraduate School

Thursday 1530-1700 - Ground Warfare
Close Support End-to-End Analysis (CSEEA) ELAN Modeling
Capt Jay Bargeron, MCCDC, Studies and Analysis

Joint Scenarios for Land, Littoral and Air to Surface Warfare
Ms. Cindy Noble, Operations Research Analyst, TRADOC

WG5B - POWER PROJECTION ASHORE

Tuesday, 1030-1200
COMPOSITE GROUP II SESSION..Ellis Hall

Diamond Hall, CR-5

Tuesday 1330-1500 - Naval Surface Fire Support
NSFS & ERGM
Mr. Alan Zimm, Senior Analyst, JHU/APL

Impact of NSFS
Mr. Evan Farris, Mr. Steve Hinds, N81/SPA

Wednesday 0830-1000
See WG5A or WG5A/6 session

Wednesday 1330-1500
See WG5A or WG5A/6 session

Wednesday 1530-1700
See WG5A or WG5A/6 session

Thursday 0830-1000
See WG5A or WG5A/6 session

Thursday 1330-1500 - Power Projection Forces
Power Projection in the 21st Century: Forces and Concepts
Mr. Louis Moore, Senior Operations Research Analyst, RAND

Using the Naval Simulation System(NSS) for Common Support Aircraft Analysis
Ms. Art Sulit, Operations Research Analyst, NAWC-AD

Thursday 1530-1700 - Special Warfare
Task Force Griffin
Stephen J. Kirin, COL, Director, TRAC, Mr. Dave Fuller, Analyst

Smoke and Obscurants in the Littoral Environment
Mr. Terry Kasey, Joint Program Office Special Technologies Countermeasures

WG5A/B - EXPEDTIONARY WARFARE/POWER PROJECTION ASHORE
POSSIBLE ALTERNATE PRESENTATIONS

DIS Compliant Model for Predicting CBW/HE Weapons Effects
Dr. Julius Lilly, Mr. William Moore, Huntsville, Alabama

Naval Surface Fire Support Requirements Analysis
Joe Stallings and Mike Althouse, Vector Research, Inc.

Tuesday 1030-1200
COMPOSITE GROUP II SESSION

Keynote Address: **By the Navy sponsor for MORS**

RADM J. W. Craine, Jr.
Director, OPNAV Assessment Division
2000 Navy Pentagon
Washington, D.C. 20350-2000

Briefing: ***MISSION AREA ANALYSIS***

Col Richard J. Linhart, Jr.
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Quantico, VA 22134-5130

This brief will discuss the new Mission Area Analysis (MAA) process recently instituted by the Marine Corps. The function of the MAA process is to identify capabilities and deficiencies in key functional areas. The MAA output is used in the development of Marine Corps requirements in our Combat Development Process. In the past, the MAA process was highly subjective and lacking in analytical rigor. The old methodology consisted of a literature search, data collection through Fleet Marine Force surveys/interviews, task validation/capabilities analysis, and an assessment conference. Oversight for the MAA process was recently reassigned to the Studies & Analysis Division, MCCDC, and is being overhauled to incorporate a much more analytically sound methodology. The new process will begin with the definition of missions and threats through 5 to 8 representative scenarios, employment of Marine forces using our official Marine Corps Concepts and Doctrine, and the usage of wargames, combat models, spreadsheet analysis, and other operations analysis tools, as well as subject matter expert forums, to define our required capabilities and deficiencies. With the new process, the Marine Corps will have an improved basis on which to measure system effectiveness, conduct trade-off analyses between competing systems, compare the effectiveness of competing systems across a wide range of scenarios, and assess various levels of risk.

Tuesday 1330-1500
Urban Warfare (URBAN WARRIOR)

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This brief will discuss the current draft (as of June 97) of the analysis plan for Urban Warrior, the second phase of the three phase (Hunter Warrior, Urban Warrior, Capable Warrior) USMC Commandant's Warfighting Lab's (CWL) Sea Dragon Advanced Concept Technology Demonstration (ACTD). In his planning guidance, the USMC Commandant states, "The laboratory (CWL) will serve as the cradle and testbed for the development of enhanced operational concepts, tactics, techniques, procedures, and doctrine which will be progressively introduced into the Fleet Marine Force (FMF) in concert with new technologies". Urban Warrior will take place from April 1997 to May 1999, and will focus on the wide spectrum of military operations in urban terrain (MOUT). The analytical methodology of Urban Warrior will include war gaming, operations analysis, and field experimentation. One lead-in war game, the CSEEA MOUT Wargame, has already been conducted and will be discussed. The Field Experimentation portion will be broken up into 1) Numerous Limited Objective Experiments (LOEs) which pursue a definitive concept or technology, and 2) One Advance Warfighting Experiment (AWE) which will focus on an experimental operational concept or concepts, supported by one or more technologies. As part of the presentation, the briefers will also discuss analysis-related lessons learned from the recently completed Phase I, Hunter Warrior. By considering these lessons learned, we hope to improve our overall analysis during this upcoming phase, Urban Warrior.

Marine Corps Ammo Requirements

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This brief will discuss various approaches for computing war reserve ammunition requirements. It will concentrate on the authors' experience in computing requirements for the Marine Corps and Navy and will provide an overview of how these two services have computed requirements in the past. The authors will discuss the relationship between POM Requirements, OpPlan Requirements, and Combat Planning Factors. Additionally, they will discuss what has been successful in the methodologies they have worked with, what hasn't worked too well, and what changes can and should be made in the short and long term to provide more defensible requirements.

*Wednesday 0830-1000 - **MCM & AMPHIB LANDINGS***
In-Stride Breaching for and Amphibious Assault

Dr. Rudolf Wiley, GS-13, Research Scientist
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A user-dendependent Analysis Engine (AE) is rigorously assembled and then applied to systemically select promising obstacle breaching solutions from a field of more than 400 candidate proposals. Assembly of the AE consists of the following 2-component effort: 1. Derivation of a set of algorithms describing the probability of collision free transit of the amphibious assault vehicles as a function of countermeasure or weapon effectiveness; 2. Rigorous configuration of a set of solution spaces describing countermeasure or weapon effectiveness as a function of countermeasure or weapon type, platform, lift, placement accuracy, and threat. (The threat includes an obstacle course bounded by adjoining mine fields.) As a case in point, 90% probability of successful transit criteria is arbitrarily selected, and applied to the MRC (W) CASE. Application of the AE in this fashion suggests that the following 2 weapon-platform systems show a high likelihood of success: 1. MCAC deployed line charges (such as ENATD) to simultaneously rubble the obstacle and mine threat in the water; 2. F/A-18 deployed passive GPS guided MK 82 bombs to rubble the obstacle threat on land by targeting on-land arrays only. (This is **not** equivalent to saturation bombing which the AE concludes to be ineffective.) Finally, it is noted that the manner in which the AE is assembled is both gernearal and rigorous enough to allow its application to a set of porposals much larger than the field of 400 considered in this study. It is also significant that the AE may be applied to the mine countermeasure problem with equal success and in formally identical fashion.

A Combat Simulation Analysis of Autonomous Legged Underwater Vehicles

CAPT Edwin Middlebrook, Professor Bard Mansager,
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Autonomous Legged Underwater Vehicles (ALUVs) are inexpensive crab-like robotic prototypes which will systematically hunt and neutralize mines en masse in the very shallow water and surf zone (VSW/SZ). With the advent of mine proliferation and the focal shift of military power to the littorals of the world, ALUVs have the potential to fill a critical need of the U.S. Navy and Marine Corps mine countermeasure (MCM) forces.

Duplicating the MCM portion of Kernal Blitz 95 exercise whenever feasible, this research used the Janus interactive combat simulation to model and evaluate the effectiveness of the ALUV as a MCM. Three scenarios were developed: an amphibious landing through a minefield using no clearing/breaching; an amphibious landing through a minefield using current clearing/breaching techniques; and an amphibious landing through a minefield using ALUVs as the clearing/breaching method. The three scenarios are compared using landing force kills, combat power ashore and percentage of mine neutralized as measures of effectiveness.

Wednesday 1330-1500 - AMPHIB OPERATIONS
ADC(X) in Support of Amphibious Operations

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Approved abstract not available at printing

Over the Horizon Amphibious Assault and Maneuver with the AAAV

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Requirement: The Program Manager for the AAAV requested that TRAC develop a scenario designed to exploit the AAAV's capabilities for use in conducting trade studies using the CASTFOREM model.

Scope: TRAC provided a force on force South-West Asia theater of operation scenario, "Blue Steele", depicting a Marine Division conducting simultaneous surface and airborne assaults to seize canal crossings and sever the enemy's Lines of Communication (LOC). A Mechanized Regimental Landing Team (RLT) conducts an over-the-horizon amphibious assault to secure a Cushion Landing Zone (CLZ) and on order moves inland to seize objectives and defend against an attack from a retrograding enemy mechanized force.

Methodology: TRADOC Analysis Center's Theater Resolution Scenario (TRS) 2.0, which is based on the Defense Planning Guidance, serves as the theater perspective and low resolution context for the High Resolution Scenario. The Mech RLT operations were dynamically gamed on the Janus Combat Model (Unix version 6.0). The scenario analyzes a mid - to high - intensity conflict involving year 2015 U.S. marine forces conducting tactical operations at night against 2015 threat forces.

Results: Not only did the scenario meet the requirements to support the AAAV trade studies but it also provides the framework for developing 21st century amphibious doctrine. Initial scenario insights pointed to issues surrounding ATGM suppression/protection, APC vs IFV, Command & Control, Combat Service Support, propulsion transition and operational depth of the battlefield.

Wednesday 1530-1700 - AMPHIB OPERATIONS

Comparing Alternative 2015 Force Structures Re Amphibious Lift and Landing

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This briefing presents a study conducted in support of a multi-lab FY95/96 Joint Littoral Warfare (JLW) Strategic Planning Effort led by the Naval Surface Warfare Center Dahlgren Division in support of OPNAV N85/86. The study makes a comparison of amphibious ship-to-shore lift capabilities of two alternative 2015 force structures. The comparison is in terms of the buildup ashore of assault echelon troops, vehicles, and cargo. The two forces are the 2015 DoD Baseline, i.e., the POM force, and the JLW 2015 Alternative Force - a JLW strategic planning force concept. The Force Potential Estimator (FPE) model developed in Dahlgren was used to compute the buildup. The JLW Force is a highly mechanized, mobile USMC MEB with USA augmentation and a large number of AAAVs. Its landing craft include a conceptual non-air cushioned, 3-tank capacity LC(X). The presentation will address study assumptions, force and lift composition, and the resulting buildup. The preliminary conclusion is that the heavy JLW force can accomplish at least as quick a buildup ashore as the lighter baseline force.

ISR Simulation for Expeditionary Operations

Richard P. Munro, Senior Analyst
Scienc Applications International Cooperation
P.O. Box 46565
Washington, DC 20050-6565
Ph: 703-697-3703 Fax 703-693-9760

Presentation highlights application of the Intelligence, Surveillance and Reconnaissance Simulation (ISRSIM) in a Lesser Regional Contingency (LRC) raid and in a Military Operation Other than War (MOOTW) situation. The purpose of the analysis was to examine the impact that several specific additional ISR system sensors have in both scenarios, given that some joint force and unit organic platforms and systems are already available. Of interest to the sponsor were programmatic recommendations concerning acquisition of additional capabilities through the POM process. The principal Measure of Effectiveness (MOE) used in both cases is the Marine Expeditionary Unit Commander's awareness through time of geographic position and movement of objective hostile mobile units in the LRC and potentially antagonistic mobs in the MOOTW. The overall MOE is a quantification of situational awareness and how that awareness changes when new capabilties are added. Communications routing and delays are considered, however the emphasis of the analysis is on the mariginal contribution made by the addition of specific systems and sensors to the mix of those already available for support of the expeditionary forces employed in both situations.

ISRSIM was the principal tool used to support the analysis because it provided the resolution necessary to quantify programmatic tradeoffs. ISRSIM animated replays and outputs will be provided.

This presentation will briefly summarize results, lessons learned and a description of expanded work in process. This product was developed for the OPNAV staff through the efforts of N812D staff, the OPNAV ISR Joint Mission Area (JMA) Working Group, SAIC and SPA, Inc. personnel. Mr. Munro works for SAIC under contract to the Navy.

Thursday 0830-1000 - Ground Warfare
Ground Warfare Modeling

Dr. Andy Ilachinski
Center for Naval Analyses
4401 Ford Avenue, PO Box 16268
Alexandria, VA 22302-0268
Ph:703-824-2447

Approved abstract not available at printing

Expeditionary Warfare Threat Environment Projections

Ms. Judy Hance/Mr. Benjamin Wong, Intelligence Specialist
Marine Corps Intelligence Activity
3300 Russell Rd., Suite 250
Quantico, VA 22134-5011
703-784-6103

This study will be a Marine Corps-specific, DIA-approved intelligence reference document that provides a baseline threat for use in modeling, simulation, planning, and analytical activities in support of weapons acquisition development. The threats to be addressed will include those likely to be found in an expeditionary environment with focus on countries of Marine Corps interest as expressed in the Marine Corps Mid-Range Threat Estimate. Timeline for the initial threat projection will be 1997 through 2010.

The study will address the Marine Corps mission, mission area, or special interest area for which the operational environment is being described. Definitions will be sufficiently detailed so as to enable the extraction of those Marine tasks/capabilities that are most sensitive to threat capabilities.

Consequently, the current and future operational, physical, and technological environment in which the Marine Corps forces, weapons, systems will have to function will be discussed. Developments and trends that can be expected to affect mission capability would be projected out to 2010. Areas covered include enemy doctrine, strategy, and tactics that will affect Marine Corps operational planning and capability. Consideration will be given to the interplay of technology and operational factors on adversary doctrine, strategy, tactics, intentions, weapon systems capabilities, force structure, force employment, training/readiness, and overall force capabilities.

Besides regional issues , current and future threat systems, their technical performance, characteristics, and capabilities will be compiled along threat hardware functional lines, providing the global technology "menu" from which assessments of applicable systems/technologies to specific foreign military forces can be made. The system specific threat to the mission capabilities of the Marine Corps will be assessed. Lastly, the study shall focus on threat systems and technologies which would affect the lethality of Marine Corps firepower against threat targets.

Thursday 1330-1500 - Ground Warfare/SOF
Joint Anti-Armor Item Level Performance Analysis

Mr. Ron Thompson, Mr. Lee Blankenbiller
U.S. Army Material Systems Analysis Activity (AMSAA)
ATTN: AMXSY-EI
392 Hopkins Road
Aberdeen Proving Ground, MD 21005-5071
410-278-6961

A Joint Staff Special Study Team was formed to look at anti-armor munitions across the services and to provide a recommendation for the optimum mix in the post 2005 timeframe. In support of that effort AMSAA conducted an Item Level Performance Analysis.

The AMSAA analysis provided the effectiveness of 29 joint service munitions (Armor, Artillery, Fixed and Rotary Wing Aviation, and Infantry) against a comprehensive set of armored targets. Integration, analysis of results and findings (which built on the AMSAA Near (2005) and Far Term (2015) Anti Armor Resource Requirements (A2R2) Item level Performance Analyses) were also provided. The primary measure of effectiveness was probability of mobility or firepower kill, per munition fired, as a function of range. For direct fire systems, accuracy from a stationary firing platform to a stationary target was used as representative. Surface indirect fire system and aircraft sensor fuzed weapon effectiveness was based on a volley of twelve submunitions vs companies of thirteen moving tanks, thirteen moving BMP and a battery of 6 stationary howitzers. The number of kills in the array divided by the twelve munitions fired is the munition probability of kill vs that target. That probability is then used in the comparisons of direct and indirect fire systems.

The AMSAA analysis is being used in the development of the 1998-2004 mini POM and is also expected to be used in support of the Quadrennial Defense Review (QDR).

High Resolution Modeling of Naval Special Warfare VSW/MCM Operations

LCDR Robert Wilson, Professor Bard Mansager,
Department of Mathematics, Naval Postgraduate School
Monterey, CA 93943
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This research explored the ways in which stochastic high resolution modeling may be utilized by maritime special operations forces (SOF) as a tool for tactics development and mission planning. Using SOF mine countermeasures (MCM) operations for illustrative purposes, this study focused upon evaluating the Janus high resolution model (HRM) as the model of choice. Model development included terrain, amphibious minefields, enemy shore-based surveillance systems, SOF MCM units and tactics pertinent to SOF mine reconnaissance operations. Model execution examined three SOF MCM search tactics in minefields laid according to enemy doctrine. Following multiple iterations, sensitivity analysis was conducted on search tactics and upon various surface support craft detection vulnerabilities.

Thursday 1530-1700 - Ground Warfare
Close Support End-to-End Analysis (CSEEA) ELAN Modeling

Capt Jay Bargeron, Analyst
MCCDC, Studies and Analysis Division
3300 Russel Rd
Quantico, VA 22134-5130
Ph: 703-784-5989

The Close Support End-to-End Analysis (CSEEA), commissioned by the Joint Staff (J8) to assess the joint close battle in concert with the Deep Attack Weapons Mix Study (DAWMS), utilized several existing combat simulation models. One of these models, ELAN, was used by the Marine Corps Combat Development Command to conduct the analyses of an amphibious assault as well as sustained operations ashore. This paper presents the highlights of this modeling effort with the emphasis on the techniques used to employ an existing combat simulation within its capabilities while meeting the demands of an ongoing joint study with limited resources.

Thursday 1530-1700 - Ground Warfare
Joint Scenarios for Land, Littoral and Air to Surface Warfare

Ms. Cindy Noble, Operations Research Analyst, TRADOC
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Ft. Leavenworth, KS 66027
(913)684-9182, Fax: x-9191
noblec@trac.army.mil

Uncertain times and decreasing resources are creating more and more joint efforts among the services. These efforts include analytic tools such as JWARS. Tools to provide insights on how the joint community can work together to defeat identified threats will soon be at hand. The Army's TRADOC Analysis Center (TRAC) is expanding the development of joint scenarios to support future joint efforts. TRAC has performed Army analyses in a joint context for numerous years. Recent efforts include the development of robust joint warfare scenarios as they support deep strike and maneuver warfare. These recent efforts will incorporate deep strike, interdiction, close air support, SEAD, theater air defense as provided by naval and ground forces, amphibious operations where applicable, maneuver warfare, surveillance, reconnaissance, joint communications, support operations and coalition forces in order to analyze our capabilities in defeating threats. These scenarios incorporate smart munitions, theater missile defense attack operations and a detailed review of deployment capabilities. Current joint scenario developments for use in analyses will be presented.

WG5B - POWER PROJECTION ASHORE -Abstracts

Tuesday 1030-1200
COMPOSITE GROUP II SESSION

Keynote Address: **By the Navy sponsor for MORS**

Navy Response to the Quadrennial Defense Review

RADM John W. Craine, Jr., USN
Director, Assessment Division (N81)
Chief of Naval Operations
2000 Navy Pentagon

Washington, DC 20350-2000
703-697-0831; FAX 693-9760

Congress legislated the Quadrennial Defense Review (QDR) in the Fiscal Year 1997 Authorization Bill. The law mandates an internal review by the Department of Defense (DoD) and the Services, plus an independent, external review by a non-partisan panel of experts (the National Defense Panel). The QDR established panels on modernization, force structure, readiness, strategy, infrastructure, and human resources.

This discussion opens with an examination of the general QDR framework. The focus then shifts to how OPNAV organized to support the QDR and how Navy responded to panel taskings to provide analytical data. Having good, responsive analytical tools in place and the ability to respond with solid analytical data were key elements in making Navy's case. Wargaming and analysis played important roles in Navy's response to addressing the challenges of affordable modernization, readiness, and force structure. Earlier development and refinement of high quality analytical tools let data drive QDR decisions, not vice versa.

Briefing: ***MISSION AREA ANALYSIS***

Col Richard J. Linhart, Jr.
Director, MCCDC, Studies and Analysis
3300 Russel Rd
Quantico, VA 22134-5130

This brief will discuss the new Mission Area Analysis (MAA) process recently instituted by the Marine Corps. The function of the MAA process is to identify capabilities and deficiencies in key functional areas. The MAA output is used in the development of Marine Corps requirements in our Combat Development Process. In the past, the MAA process was highly subjective and lacking in analytical rigor. The old methodology consisted of a literature search, data collection through Fleet Marine Force surveys/interviews, task validation/capabilities analysis, and an assessment conference. Oversight for the MAA process was recently reassigned to the Studies & Analysis Division, MCCDC, and is being overhauled to incorporate a much more analytically sound methodology. The new process will begin with the definition of missions and threats through 5 to 8 representative scenarios, employment of Marine forces using our official Marine Corps Concepts and Doctrine, and the usage of wargames, combat models, spreadsheet analysis, and other operations analysis tools, as well as subject matter expert forums, to define our required capabilities and deficiencies. With the new process, the Marine Corps will have an improved basis on which to measure system effectiveness, conduct trade-off analyses between competing systems, compare the effectiveness of competing systems across a wide range of scenarios, and assess various levels of risk.

Tuesday 1330-1500 - Naval Surface Fire Support
Naval Surface Fire Support (NSFS) & Extended Range Guided Projectile (ERGM)

Mr. Alan Zimm, Senior Analyst, JHU/APL
Johns Hopkins Road
Laurel, MD 20723-6099
Ph: 301-953-5462

The Navy is currently making a major effort towards upgrading the capabilities of NSFS. The Extended Range Guided Projectile (ERGM) has been contracted for development, and there are other weapons such as the ERGM P3I, Low Cost Competent Munitions, and various strike missiles proposed.

The analysis consists of two parts: first, an assessment of the lethality of the ERGM and other weapons, considering Target Location Error, Circular Error Probable, Target Characteristics, Dispense Diameter, and other variables. Second, the various weapons systems are incorporated into a battle-level simulation process which included separate models for ground direct fire, fire support, and close air support/air interdiction. Measures of effectiveness are shown keyed to the tenets of maneuver warfare.

Tuesday 1330-1500 - Naval Surface Fire Support
Impact of Naval Surface Fire Support on Amphibious Operations

Mr. Evan Farris, Mr. Steve Hinds, N81/SPA
2000 N. Beauregard St
Alexandria, VA 22311
Ph: 703-578-5667/5653

The impact of future options for naval surface fire support (NSFS) on MEF amphibious operations in a Major Regional Conflict (MRC) scenario was assessed as part of a campaign analysis conducted by the N81 Joint Campaign Analysis Section. NSFS options included both current and improved naval gunfire munitions and Vertical Launch System (VLS) missile options. The analysis quantified the impact of these options on overall MEF warfighting effectiveness, measured in terms of own force losses, enemy forces neutralized, and force buildup ashore.

The General Campaign Analysis Model (GCAM) was used to integrated supporting warfare task and mission-level analyses to

develop an integrated MEF amphibious operations case including ship-to-objective movement, ground combat close air support (CAS), battlefield air interdiction (BAI), NSFS, and mine countermeasures (MCM). NSFS options were analyzed within the context of this integrated case to capture synergy between employment of naval, air, and amphibious forces. The analysis focused on use of NSFS to suppress enemy artillery during ship-to-objective movement and maneuver of forces ashore. The impact of NSFS options on MEF warfighting effectiveness was measured in terms of own forces survivability over time, enemy forces neutralized over time, and total force buildup ashore.

This presentation will include a GCAM visualization of the MRC amphibious warfare scenario, a description of NSFS employment in the scenario, and a comparison of results for different NSFS excursions.

Wednesday 0830-1000

See WG5A or WG5A/6 session

Wednesday 1330-1500

See WG5A or WG5A/6 session

Wednesday 1530-1700

See WG5A or WG5A/6 session

Thursday 0830-1000

See WG5A or WG5A/6 session

Thursday 1330-1500 - Power Projection Forces

Power Projection in the 21st Century: Forces and Concepts

Mr. Louis Moore, Senior Operations Research Analyst, RAND
1700 Main St, PO Box 2138
Santa Monica, CA 90407-2138
Ph: 310-393-0411

This presentation describes a project which assisted the Early Entry, Lethality and Survivability (EELS) Battle Lab in assessing concepts and forces for projecting power in various situations that the Army may face in the future. These concepts emphasize the new capabilities and forces envisioned by EELS studies, which initially focused on the organization, effectiveness, supportability, and deployability of early entry forces. The 10K Base force is an existing division(-) with 1999 projected equipment. The 10K Org force is a reorganization of the 10K Base force with added MLRS and attack helicopters. The 10K Rec force was recommended in the TRAC "Middleweight" study. It is the 10K Base force with technologically enhanced close battle capability.

The project helped the EELS Battle Lab evaluate the effectiveness of such forces. It also examined ways in which the effectiveness of those forces depends on such scenario factors as objectives, terrain, timing, enemy capabilities, and constraints on force employment. This evaluation was conducted at the operational and theater levels, deploying the early entry forces to nearly simultaneous MRCs both in Southwest and Northeast Asia.

Using the Naval Simulation System (NSS) for Common Support Aircraft (CSA) Analysis

Art Sulit, GS-12, Operations Research Analyst
Concept Analysis, Evaluation and Planning Department (4.10.3)
Naval Air Warfare Center-Aircraft Division
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Sulit_Arthur%PAX5a@MR.NAWCAD.NAVY.MIL

The Naval Simulation System is an object-oriented computer model developed by Metron and based on the Composite Warfare Model (CWM). This model has recently been delivered to the Navy for evaluation. Real-world operational inputs will be obtained from the CSA program to evaluate the simulation capabilities of the model. NSS features explicit modeling of C4ISR (Command, Control, Communications, Computers and Intelligence, Surveillance and Reconnaissance), which is of special interest in the design of the CSA. The analysis will evaluate the capabilities of NSS for single- and multi-mission effectiveness analyses.

Thursday 1530-1700 - Special Warfare

Task Force Griffin - "The Task Force is dependent on long-range precision fires from organic Army, Navy and Air Force systems to attack identified targets."

Stephen J. Kirin, COL, Director, TRAC
David L. Fuller, GS-13, Operations Research Analyst
TRAC Study and Analysis Center
255 Sedgwick Ave
Ft Leaventworth, KS 66027-2345
Ph: 913-684-9312

The U.S. Army Training and Doctrine Command's (TRADOC) Analysis Center (TRAC) formed Task Force Griffin to analyze a small, potentially lethal unit that exploits stealth, speed, and strike capabilities. Task Force Griffin is designed to provide a rapid-reaction, early-entry, and area-denial for he 21st Century Army, circ 2015 and beyond. This force had to counter a robust guerrilla insurgency and be prepared to halt the attack of a neighboring country equipped with heavy conventional forces. The analysis examined several variants of this task force. These alternatives were created by varying capabilities of organic sensors, certain weapons systems' ranges, and the organic mobility available to each team. In each case, the Task Force was able to counter the guerilla threat and halt the conventional attack, although there are differences in the level of effectiveness against the guerrillas and the depth of penetration achieved by the opponent's forces. **The Task Force is dependent on long-range precision fires from organic Army, Navy and Air Force systems to attack identified targets.** This effort parallels the Marine Corps' Hunter concept with Task Force Griffin using similar technologies and capabilities.

TRAC conducted this analysis to support the 1996 Defense Science Board's (DSB) Task Force on Tactics and Technology for 21st Century Military Superiority. This briefing was presented to the DSB on 8 August 1996 and a portion of the slides appeared in the DSB final brief to the Secretary of Defense on 16 August 1996.

Smoke and Obscurants in the Littoral Environment

Mr. Terry Kasey, Joint Program Office Special Technologies Countermeasures

During Desert Storm/Shield, it became apparent that the Iraqi army was trying to reduce the warfighting capability of the coalition by using visual obscurants (oil fires) along the Kuwaiti coast. There is every reason to believe that in future conflicts the use of obscurants will continue and worsen once the users realize that the range of obscuration necessary extends far above and below visible light bands. Given that this is the case, the US needs the ability to engage in an effective counter-smoke effort. First we must be able to monitor the level of obscuration (on a real-time basis) on the battlefield to determine the potential impact of those obscurants on own forces. Second, we should be able to take away the advantage of obscuration by employing own-force-friendly obscurants to interfere with the adversary's sensors. Finally, we must assure that our own systems perform satisfactorily in this multi-level obscurant environment.

WG5A/B - EXPEDTIONARY WARFARE/POWER PROJECTION ASHORE POSSIBLE ALTERNATE PRESENTATIONS - ABSTRACTS

DIS Compliant Model for Predicting CBW/HE Weapons Effects

Dr. Julius Lilly, Mr. William Moore, Huntsville
PO. Box 1500 Attn: CSSD-TC-WL
Huntsville, AL 35807
Ph: 205-955-3059

The Lethality Division of the Weapons Directorate of the United States Army Space and Strategic Defense Command (USASSDC) has developed the Post Engagement Ground Effects Model (PEGEM) to provide Chemical and Biological Weapon (CBW) and High Explosive (HE) hazard assessment in the form of ground collateral effects. PEGEM represents a true multi-service effort with contributions from the Army, Navy, Air Force, as well as other government agencies and their contractors. Output of the program is in the form of agent cloud position and dimensions, agent coverage area, as well as resulting estimated casualties at user-specified times-of-interest. In addition PEGEM supports the AURA model through dedicated outputs and Extended Air Defense Simulation/Extended Air Defense Test Bed (EADSIM)/EADTB) with a real-time Distributed Interactive Simulation (DIS) interface. PEGEM can supply supporting analysis for acquisitions and is a valuable tool to evaluate individual and integrated theater missile defense systems. PEGEM is designed primarily for hit-to-kill (HTK) interceptor technology, however, some constituent models have a fragmenting warhead interceptor technology capability.

PEGEM is an integration of several previously existing and new models. Typically an analyst specifies a multiple threat scenario including all threat details and the locations and times of the theater ballistic missile events. Lethality information is provided through the output of the Parametric Endo/Exo-atmospheric Lethality Simulation (PEELS) code. High altitude and boundary layer atmospheric transport is carried out by the Vapor, Liquid, and Solid Tracking (VLSTRACK) model. Surviving submunitions are propagated to the ground using one of two newly developed semi-empirical flyout models, tailored to the munition characteristics. Once ground impact locations of the munitions are estimated and atmospheric transport calculations completed, casualty estimations are generated based on current CBW toxicology standards. In addition unit effectiveness can be addressed with the simulation AURA which is accessible through the PEGEM interface. The force-on-force model EADSIM and others can be accessed, via the DIS interface, to estimate the effects CBW agents in the battlefield. All of these capabilities are integrated into a seamless architecture for ease of use.

Fiscal year 1994 was the period of primary development for PEGEM. Fiscal year 1995 was the initial release period along with many improvements and upgrades to the code. Fiscal year 1996 efforts were concerned with expanding PEGEM model input databases, expanding platform compatibility, generating complete documentation, and model verification and validation (V&V). Version 2.0 of PEGEM was released Fall 1996. Fiscal year efforts 1997 will be primarily concerned with accrediting the code under the sponsorship of the Ballistic Missile Defense Organization (BMDO).

Forward Presence and Crisis Response

Dr. Henry Gafney, Center for Naval Analyses
4401 Ford Avenue, PO Box 16268
Alexandria, VA 22302-0268
Ph:703-824-2975

Approved abstract not available at printing

Naval Surface Fire Support Requirements Analysis

Joe Stallings, Program Scientist
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Vector Research, Inc., POB 1506
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stallinj@vrinet.com

WG 6—Littoral Warfare and Regional Sea Control—Agenda
Chair: CDR Michael Shumaker, Office of the CNO, N81
Cochairs: Kirk Bretney, Hughes Aircraft Company
Prof Carlos F. Borges, Naval Postgraduate School
Paul Cassiman, Kapos Associates, Inc
Jack Keane, Strategic Insight Ltd
Advisor: Dr. Steven Pilnick, Global Associates Ltd
Room: Diamond Hall – CR-6

Tuesday, 1030-1200
COMPOSITE GROUP II SESSION...Ellis Hall

Room: Diamond Hall – CR-6

Tuesday 1330-1500
1997 ASW Assessment
CAPT John G. Morgan, Jr., USN, Director, Anti-Submarine Warfare Requirements Division (N84)

Wednesday 0830-1000
JWARS From an R&D Perspective
Ms. Janice Gess, NAWC-AD

Representation of Joint Maritime Operations in JWARS
LCDR Jeffrey R. Cares, USN and Maj Barry D. Justice, USMC, JWARS Office of OSD(PA&E)

Wednesday 1330-1500
2005 Major Theater War (MTW)--West Campaign Analysis
Mr. W. Dean Free, Ms. Robbin Beall, and Dr. Michael P. Bailey, Assessment Division (N81)

Wednesday 1530-1700
Innovative Rising Adversarial Power (IRAP)
Mr. Clifford S. Perrin, McDonnell Douglas Aerospace

Thursday 0830-1000
Implicit Searches in Combat Models
LCDR Jeffrey R. Cares, USN, JWARS Office of OSD(PA&E)

CVX Cost and Operational Effectiveness Analysis
Dr. David A. Perin and Mr. John B. Newman, CNA

Thursday 1330-1500
Flexible Presence: A Concept for the 21st Century
Drs. Sean Barnett and Jim Thomason, IDA

Carrier Forward Presence and Crisis Response: What Carrier Fleet Size is Enough?
CDR Kirk A. Michealson, USN, Naval Forces Division of OSD(PA&E)

Thursday 1530-1700
Campaign Analysis : Determining Command and Control Requirements in Surface Combatants
CAPT Paul A. Cassiman, USN (Ret.), Kapos Associates

An Organizing Study for Regional Conflict in the Littorals
Mr. Charles R. Hall, Mitre Corporation

Tuesday, 1030 - 1200
Navy Response to the Quadrennial Defense Review

RADM John W. Craine, Jr., USN
Director, Assessment Division (N81)
Chief of Naval Operations
2000 Navy Pentagon
Washington, DC 20350-2000
703-697-0831; FAX 693-9760

Congress legislated the Quadrennial Defense Review (QDR) in the Fiscal Year 1997 Authorization Bill. The law mandates an internal review by the Department of Defense (DoD) and the Services, plus an independent, external review by a non-partisan panel of experts (the National Defense Panel). The QDR established panels on modernization, force structure, readiness, strategy, infrastructure, and human resources.

This discussion opens with an examination of the general QDR framework. The focus then shifts to how OPNAV organized to support the QDR and how Navy responded to panel taskings to provide analytical data. Having good, responsive analytical tools in place and the ability to respond with solid analytical data were key elements in making Navy's case. Wargaming and analysis played important roles in Navy's response to addressing the challenges of affordable modernization, readiness, and force structure. Earlier development and refinement of high quality analytical tools let data drive QDR decisions, not vice versa.

Briefing: ***MISSION AREA ANALYSIS***

Col Richard J. Linhart, Jr.
Director, MCCDC, Studies and Analysis
3300 Russel Rd
Quantico, VA 22134-5130

This brief will discuss the new Mission Area Analysis (MAA) process recently instituted by the Marine Corps. The function of the MAA process is to identify capabilities and deficiencies in key functional areas. The MAA output is used in the development of Marine Corps requirements in our Combat Development Process. In the past, the MAA process was highly subjective and lacking in analytical rigor. The old methodology consisted of a literature search, data collection through Fleet Marine Force surveys/interviews, task validation/capabilities analysis, and an assessment conference. Oversight for the MAA process was recently reassigned to the Studies & Analysis Division, MCCDC, and is being overhauled to incorporate a much more analytically sound methodology. The new process will begin with the definition of missions and threats through 5 to 8 representative scenarios, employment of Marine forces using our official Marine Corps Concepts and Doctrine, and the usage of wargames, combat models, spreadsheet analysis, and other operations analysis tools, as well as subject matter expert forums, to define our required capabilities and deficiencies. With the new process, the Marine Corps will have an improved basis on which to measure system effectiveness, conduct trade-off analyses between competing systems, compare the effectiveness of competing systems across a wide range of scenarios, and assess various levels of risk.

Tuesday, 1330-1500
1997 ASW Assessment

CAPT John G. Morgan, Jr., USN
Director, Anti-Submarine Warfare Requirements Division (N84)
Chief of Naval Operations
2000 Navy Pentagon
Washington, DC 20350-2000
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This briefing provides the current status of the 1997 ASW Assessment. It highlights the operational analysis used to arrive at the assessments findings and recommendations. The analysis was directed at ASW systems and sensors and not at multi-mission force structure implications.

Wednesday, 0830 - 1000
JWARS From an R&D Perspective

Ms. Janice Gess
Concepts, Analysis, Evaluation and Planning Department
Naval Air Warfare Center-Aircraft Division
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The Joint Warfare System (JWARS) is being developed as the DOD joint warfare model to be used for course of action analysis, analysis of alternatives, force sufficiency studies, force and system-level tradeoff analysis across the DOD organizations. Currently, several joint warfare methodologies are being used to analyze naval systems: the Joint Strike Fighter Program is using the USAF model THUNDER, the SC-21 Program is using ITEM and TACWAR, and N81 uses several models to evaluate programs during the POM assessment process. JWARS is being developed with emphasis on Communications, Command, Control, Computers and Intelligence, Surveillance, and Reconnaissance (C4ISR) representations. It is to be designed to include the spectrum of warfare and mission areas across the services including special operations, peacekeeping and joint theater warfare. It is to provide its initial operational capability in two years. Many issues can be evaluated relative to the modeling of joint warfare and this paper will reflect on such issues as: modeling future doctrine, technological forecasting and modeling C2 vs. Communications vs. Decision making. The R&D community has a special interest in this joint warfare model as it plans its programs that will provide the future naval weapon systems.

Representation of Joint Maritime Operations in JWARS

LCDR Jeffrey R. Cares, USN and Maj Barry D. Justice, USMC
JWARS Office,
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The Department of Defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The representations in JWARS of Navy and Marine Corps contributions to Expeditionary Warfare, Power Projection Ashore, Littoral Warfare, and Regional Sea Control will have a profound impact on future force structure, procurement and planning decisions. This brief will provide an overview of the types of analyses JWARS will support, a discussion of the methods by which JWARS will represent maritime forces, and a report on the status of JWARS development. The presentation will also include a detailed discussion of theater-level naval warfare Essential Elements of Analysis (EEAs), Measures of Effectiveness (MOEs) and Measures of Performance (MOPs) central to JWARS development.

Wednesday, 1330 - 1500
2005 Major Theater War (MTW)--West Campaign Analysis

Mr. W. Dean Free, Ms. Robbin Beall, and Dr. Michael P. Bailey
Office of the Chief of Naval Operations (N81)
2000 Navy Pentagon
Washington, DC 20350-2000
703-697-3642; FAX 703-693-9760; freed@spawar.navy.mil, mike@nps.navy.mil

A Major Theater War (MTW)-West conflict was analyzed from the joint forces perspective with a spotlight on Naval forces. The scenario was based on the Defense Planning Guidance (DPG). The study objectives were to show the impact of Naval forces on the land war and to provide a common campaign analysis baseline for DoN excursions and Investment Balance Review (IBR) issues. The goal was to measure the effect of different Blue forces, systems and their employment on the outcome of the conflict. Warfighting effectiveness was measured in terms of force generation/access to theater, Blue losses and ground war results.

Various modeling tools, including the General Campaign Analysis Model (GCAM), battlespace dominance/logistics models, the Integrated Theater Engagement Model (ITEM) and TACWAR were used to assess ground, sea, undersea, air, and amphibious operations at a suitable level of resolution to determine programmatic payoffs. The briefing will include a GCAM animation of a large, complex amphibious operation.

This briefing will describe baseline results. It will also address lessons learned as a result of integrating diverse models to support the analysis, and the application of current technology to automate the integration process. The product represents the work of the N812D staff, the Space and Naval Warfare Systems Command (PMW131), and personnel from Systems Planning and Analysis, Inc., and SAIC.

Wednesday, 1530 - 1700
Innovative Rising Adversarial Power (IRAP)

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Many of today's weapon systems will serve well into the next century, and the generation of systems now in development may well serve to the mid-point of that century. Yet, the process under which US weapons are developed still lacks a systematic means of exploring more than the first few years of the future environment in which those systems will have to perform their missions. Specifically, the two near-simultaneous MRCs planning scenario underlying OSD's FYDP and DoD's budget does not attempt to provide rationale for procurement beyond the FYDP; consequently, it cannot provide a sound basis for long term acquisition planning.

The work reported here explores a scenario further in the future than those currently being used for force planning. The report covers the results and insights derived from two wargames conducted in August and October of 1996. In those wargames, the US players sought to reverse aggression undertaken by a new and clever adversary called IRAP (short for Innovative Rising Adversarial Power). The shape of IRAP and its forces arose from the following considerations.

In addition to being today's sole superpower, the US is formally allied or informally aligned with the bulk of the world's other major military powers. Consequently, a challenge to US security interests in the 2020 time frame would probably involve a nation outside today's major alliances. That nation's military would have to be sufficiently professional to prepare realistically and effectively for international conflict, and it would need an expanding economy in order to support that preparation without unacceptably reducing its people's economic progress. In confronting the US, such a nation could be expected to seek to counter US strengths through the application of technology and through the employment of innovative operational techniques executed by thoroughly-trained troops.

The first US-IRAP wargame, one in which innovations were not employed by IRAP, helped establish a baseline. Under those circumstances, US forces equipped only with systems now in the FYDP were able to foil IRAP's attempt to occupy a neighboring state. In the second wargame, in which IRAP was allowed to employ innovative systems and operational concepts, those same US forces could not turn the tide. It is not surprising that US planning for conflict beyond the FYDP will have to be no less innovative than that of potential foes in that time frame, and it is therefore of concern that--despite frequent lip-service--mechanisms to introduce such innovations remain underdeveloped.

Our aim in this and future work involving potential conflicts with IRAP is to gain insight into what kinds of challenges it would present, turning those insights into recommendations regarding development of future weapon systems and technology.

Thursday, 0830 - 1000

Implicit Searches in Combat Models

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The Department of Defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical modest currently used have become less

effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art orient simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version f the Joint Warfare System.

Since the model will require many thousands of interactions between hundreds of objects while the users will require fat run times, the JWARS Office is very interested in alternative, computationally efficient algorithms. The JWARS development team devised a new method of representing the classic military OR problem: random searches at sea. This method involves implicitly representing many of the exhaustive computations previously required to represent random searches. The brief will describe this new method.

CVX Cost and Operational Effectiveness Analysis

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On 29 March 1996 the Navy was granted Milestone 0 to enter concept exploration for a new class of sea-basing platform for tactical aircraft, commonly known as CVX. A focal point of the concept exploration process is the CVX Milestone I Cost and Operational

Effectiveness Analysis (now officially known as the Analysis of Alternatives). The COEA will assess the cost and operational effectiveness of seven broad concepts identified in the OSD COEA guidance. The options include nuclear and non-nuclear propulsion concepts, CTOL and STOVL aircraft, and air wings ranging from 40 to 80 aircraft. The COEA is also addressing the concept of a the Mobile Offshore Base. The presentation will describe the structure of the COEA and discuss some of its preliminary findings on cost and effectiveness of alternative CVX concepts.

Thursday, 1330 - 1500
Flexible Presence: A Concept for the 21st Century

Drs. Sean Barnett and Jim Thomason
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With the end of the Cold War and a shrinking armed forces, some question the value to the United States of overseas military presence. We believe presence is important to furthering key objectives of our national security strategy. This paper discusses why presence is an important issue, the objectives of presence in the context of the national security strategy, and how presence operations can achieve those objectives. It concludes that CINCs and Joint Staff planners should think about presence globally—anywhere it might best support our strategy. To maximize our presence reach, they should consider the capabilities of all the Services, and plan to conduct operations using situationally tailored force packages. Accordingly, they should break the Navy and Marine Corps out of their schedules of deployment to traditional areas of responsibility, and use maritime assets as parts of tailored force packages whenever required to achieve our objectives. Finally, when thinking about deterrence, planners should focus on small Navy and Marine Corps task forces deployed forward, backed up by rapidly deployable forces from CONUS. They should exploit the capabilities of maritime forces to loiter near the scenes of developing crises to deter conflict, and of CONUS based forces to strike or reinforce quickly if needed. Flexible presence should be the guiding concept for the 21st century.

Carrier Forward Presence and Crisis Response: What Carrier Fleet Size is Enough?

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The Navy's aircraft carriers provide a forward base for maritime air operations, as well as support facilities for joint force commanders. Operating independent of land-basing restrictions, carriers support joint forces by conducting attack, surveillance, air defense, and electronic warfare missions against targets at sea, in the air, or ashore. Beyond their combat roles, aircraft carriers continue to be a mainstay in quelling crises and in supporting peacekeeping operations because they are forward deployed worldwide in support of U.S. strategy and commitments.

In this era of fiscal uncertainty in the Department of Defense, however, there is a real possibility that the amount of future procurement dollars will decrease, and as a result, the future carrier force structure may be smaller. As we decrease the number of carriers in the inventory while maintaining 6-month deployments and the Navy's current PERSTEMPO policies, larger presence gaps are created in forward areas. These larger presence gaps increase the risk that carriers will not be in position to respond to a crisis in a timely manner, and fewer carriers will delay arrivals in two nearly simultaneous Major Theater War (MTW).

This brief discusses analysis that estimates the effects of a reduced aircraft carrier fleet on forward presence and crisis response. Specifically, the analysis compares the presence available, the percent of time a carrier can respond to a crisis, the expected number of days required to respond to a crisis, and the difference in arrival times in the 2-MTW scenario for carrier-fleets of 12, 11, 10 and 9 carriers.

Thursday, 1530 - 1700
Campaign Analysis : Determining Command and Control Requirements in Surface Combatants

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During 1995 and 1996, campaign analyses were conducted using the Naval Planning Scenario - Lesser Regional Contingency, Sea Lines of Communication (East) to identify command and control requirements that should be considered as part of surface combatant design.

These analyses were conducted first to support the Cost and Operational Effectiveness Analysis (COEA) for SC-21 and again for Phase I of Arsenal Ship.

The COEA process for warfighting systems, such as a warship, tends to focus naturally on the warfighting functions first and foremost. Support functions, however, are also very important. Ignoring or not analyzing these functions sufficiently may result in significant omissions in the ship's ability to conduct prompt and sustained combat operations from the sea. Therefore, campaign analysis was used to look at support functions—command and control, as well as logistics, in both cases— focusing not only on the individual combat platform, but also on the platform as it relates to the battle force and joint forces.

The LRC-SLOC scenario was expanded to give it sufficient detail to enable close examination of the operational activities of the surface combatant and the tactical formation in which it operated. This examination was conducted across the entire campaign, beginning with peacetime presence through hostilities to its conclusion, by taking detailed cross-sectional analyses at important junctures within each phase of the campaign. Organizational structures were defined at each of these junctures, and from these structures, command and control requirements that should be considered as part of ship design were then derived.

An Organizing Study for Regional Conflict in the Littorals

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Approved abstract not available at printing.

WG 7 - Nuclear, Biological, and Chemical Defense - Agenda
Chair: Michael O. Kierzewski, OptiMetrics, Inc.
CoChair: Debbie Lott, US Army Nuclear and Chemical Agency
CoChair: Miles Miller, US Army Edgewood Research Development and Engineering Center
Advisor: Doug Schultz, Institute for Defense Analyses
Room: C&SC – CR-226 and CR-102

Room: C&SC – CR-226

Tuesday, 1030-1200

What can they do to us?
(Threat, proliferation issues, and effects analyses)

Third Party Threats in a Multi-Polar World (30 min)
Mr. Kyle B. Olson, TASC, Incorporated

A DIS Compliant Model for Predicting CBW and HE Weapons Effects on the Virtual Battlefield (30 min)
Mr. Kevin Bruening, MEVATEC Corp.

Chemical and Biological Defense Planning: Interaction with Indigenous Elements (30 min)
Mr. William R. Davis, Simulation Technologies, Incorporated

Tuesday, 1530-1700

What can they do to us? *continued*
(Threat, proliferation issues, and effects analyses)

Employment of Weapons of Mass Destruction (WMD) in an MRC Warfight (30 min)
Mr. Michael A. Ottenberg, OSD PA&E SAC

US Ground Forces on Attack, Analytical Support for the 1996 Counter Proliferation Front-End Assessment (30 min)
MAJ Jerry Glasow, Concepts Analysis Agency; Mr. Douglas P. Schultz, IDA

Counter Proliferation Front-End Assessment Bio Terrorism (30 min)
Ms. Julia Clare, Institute for Defense Analyses Defense Nuclear Agency

Wednesday, 0830-1000

COMPOSITE GROUP III SESSION .... Ellis Hall

Room: C&SC – CR-102

Wednesday, 1330-1500

How can we protect ourselves? I
(Command, control, and communications)

A Prototypical Expert System to Assist Army Chemical Officers in Passive Defense Recommendations (30 min)
LTC John Marin and Prof. Donald Barr, United States Military Academy

Fuzzy Expert Decision Making in Constructive Simulation (FEDICS) (30 min)
Mr. Michael J. Smith, US Army Edgewood Research, Development and Engineering Center

How can we protect ourselves? II
(Passive defense analyses)

A Quick Response Approach to Assessing the Operational Performance of the XM93E1 NBCRS Through the Use of Modeling and Validation Testing (30 min)
Mr. Richard McMahon, Army Research Laboratory, Human Research and Engineering Directorate

Wednesday, 1530-1700

How can we protect ourselves? II *continued*
(Passive defense analyses)

Analysis of Joint Remote Detection and Early Warning. Phase I: Ground Forces (30 min)
Mr. Douglas P. Schultz, Institute for Defense Analyses

Modeling the Impact of Vaccine Effectiveness Rates in Biological Defense (30 min)
Mr. Steven R. Hursh, Science Applications International Corporation

A Mathematical Model for Extending BW Casualty Prediction to Secondary Contagious Effects (30 min)
Mr. Joseph F. Fanzone, Science Applications International Corporation

Thursday, 0830-1000

Does anyone remember how this thing works?
(Complex tools, their use and abuse)

KNOWLEDGE SHARING AND THE VIRTUAL ORGANIZATION: A U.S. Federal Agency's Approach to Restructuring to Meet 21st Century Challenges(30 min)
Ms. Leslie J. Rae, Science Applications International Corporation

We don't have to take this lying down!
(Active defense and counter proliferation measures)

An Assessment of Using Radiological Sources for Access Denial. (30 min)
Mr. John St. Ledger, Los Alamos National Laboratory

Hit-to-Kill Interceptor-Bulk Chemical Payload In Situ Negation. (30 min)
Dr. Martin Richardson, Teledyne Brown Engineering

Thursday, 1330-1500

Does anyone remember how this thing works? *continued*
(Complex tools, their use and abuse)

Automated NBC Hazard Prediction Tools: Comments from the Field (30 min)
Mr. Jack Berndt, OptiMetrics, Inc.

Utility of Detailed Hazard Predictions in an Operational Scenario. Results from 64th MORSS Working Session.(30 min)
Mr. Michael Kierzewski, OptiMetrics, Inc.

What do we really know?
(Field test data)

Chemical Weapons Field Test Archive Database (30 min)
Mr. Andrew Blackburn, Battelle

Thursday, 1530-1700

So you've decided to clean up your act.
(Demilitarization and environmental issues)

Technical and Economic Analysis Comparing Alternative Chemical Demilitarization Technologies to the Baseline. (30 min)
Carl M. Eissner, US Army Materiel Systems Analysis Activity

Working session: The Way Ahead
Miles Miller, US Army Edgewood Research, Development and Engineering Center

WG 7 - Nuclear, Biological, and Chemical Defense Working Group - Abstracts

Tuesday, 1030-1200
Third Party Threats in a Multi-Polar World

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In the years since the Gulf War, the arguments have been made that chemical and biological weapons (CBW) should not be viewed as equivalent to nuclear weapons, and that modern conventional capabilities are a very effective counterbalance. but what happens in the event of a successful chem or bio attack against a nuclear power which does not enjoy the American luxury of overwhelming conventional forces: The potential use of CBW in this context poses dramatic, unanswered security questions for the United States.

In the aftermath of a moderately effective CBW attack (10-50,000 fatalities), any foreign government would be under tremendous pressure to respond with maximum force, the goal being to inflict disproportionately heavy casualties on the attacker. For a wounded nation's people and leaders, nuclear retaliation could be justified militarily, politically, and even morally.

Depending on the scenario, Washington, would be forced to choose among several equally unattractive responses, each with profound political and military consequences.

1. Diplomatic intervention, in a probably ineffective effort to reach a peaceful resolution.
2. Military assistance/intervention, lending US conventional forces to a punitive action against the aggressor as a hedge against a nuclear response.
3. Hands off, essentially sanctioning a nuclear response.
4. Unilateral US "police action."

There is a clear need to reassess the potential threat of CBW from other than an American-centric perspective. The domino effect of a WMD use against a nuclear or near-nuclear state represents a significant, unstudied element in the international security equation.

A DIS Compliant Model for Predicting CBW and HE Weapons Effects on the Virtual Battlefield

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The Lethality Division of the Weapons Directorate of the US Army Space and Strategic Defense Command (USASSDC) has developed the Post Engagement Ground Effects Model (PEGEM) to provide Chemical and Biological Weapon (CBW) and High Explosive (HE) hazard assessment in the form of ground collateral effects. PEGEM represents a true multi-Service effort with contributions from the Army, Navy, Air Force, as well as other government agencies and their contractors. Output of the program is in the form of agent cloud position and dimension, agent coverage area, as well as resulting estimated casualties at user-specified times of interest. In addition, PEGEM support the Army Unit Resiliency Analysis (AURA) model through dedicated output and Extended Air Defense Simulation/Extended Air Defense Test Bed (EADSIM/EADTB) with a real-time Distributed Interactive Simulation (DIS) interface. PEGEM can supply supporting analysis for acquisitions and is a valuable tool to evaluate individual and integrated theater missile defense systems. PEGEM is designed primarily for hit-to-kill (HTK) interceptor technology, however, some constituent models have a fragmenting warhead interceptor technology capability.

PEGEM is an integration of several previously existing and new models. Typically an analyst specifies a multiple threat scenario including all threat details and the locations times of the theater ballistic missile events. Lethality information is provided through the output of the Parametric Endo/Exo-atmospheric Lethality Simulation (PEELS) code. High altitude and boundary layer atmospheric transport is carried out by the Vapor, Liquid and Solid Tracking (VLSTRACK) model. Surviving submunitions are propagated to the ground using one two newly developed semi-empirical flyout models, tailored to the munition characteristics. Once ground impact locations of the munitions are estimated and atmospheric transport calculations completed, casualty estimates are generated based on current CBW toxicology standards. In addition unit effectiveness can be addressed with the simulation AURA which is accessible through the PEGEM interface. The force-on force model EADSIM and others can be accessed via the DIS interface to estimate the effects of CBW agents in the battlefield. All of these capabilities are integrated into a seamless architecture for ease of use.

Fiscal year 1994 was the period of primary development for PEGEM. Fiscal year 1995 was the initial release period along with many improvements and upgrades to the code. Fiscal year 1996 efforts were concerned with expanding PGEM model input databases, expanding platform compatibility, generating complete documentation, and model verification and validation (V&V). Version 2.0 of PEGEM was released Fall 1996. Fiscal year 1997 efforts will be primarily concerned with accrediting the code under the sponsorship of the Ballistic Missile Defense Organization (BMDO).

Chemical and Biological Defense Planning: Interaction with Indigenous Elements

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Current United States Air Force Chemical and Biological Defense (CBD) planning emphasizes continued operations within the confines of the air base without regard to the local civilian populace. These air bases are located in foreign countries where CB attacks would place the local population at risk. Wherever possible, defensive plans should address this risk, both for humanitarian reasons and because local reaction to such attacks may be detrimental to operational capability.

Even the threat of such attacks might provoke response from indigenous elements which would be inimical to operations. Anticipation of local response, co-opting indigenous defensive elements, coordinated planning and information exchange should all be considered as key elements of a comprehensive CBD plan.

This paper will discuss the issues involved with incorporating these elements in CBD planning and explore the potential risks predicted by computer simulations.

Tuesday, 1530-1700

Employment of Weapons of Mass Destruction (WMD) In an MRC Warfight

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Threat countries may employ Weapons of Mass Destruction (WMD) to provide the combat power required to defeat US and Allied forces in future contingencies. What risks do WMD place on US force structure, strategic mobility, and modernization programs within the context of a nearly-simultaneous dual MRC set of contingencies? Moreover, how should US medical components be structured and supplied to respond to potential WMD usage?

This briefing describes how the Simulation and Analysis Center (SAC) -- as a member of the Joint Collaborative WMD Analysis (JCAC) effort co-chaired by J-8 and J-4 -- analyzed US force sufficiency and capability issues in a Weapons of Mass Destruction (WMD) environment. In particular, this effort determined the warfight risks associated with threat employment of lethal chemical weapons in an MRC warfight. Answers to these issues will support analysis of long term re-capitalization issues -- particularly in the areas of tactical missile and chemical defenses as well as counter-SSM assets. Force structure and modernization issues will contribute to on-going defense reviews. In addition, the study improves the analytical community's tools by validating upgraded theater models - - TACWAR -- for WMD analyses. The analysis was conducted for the Theater Assessment and Planning (TA&P) Deputate and forms the ODPA&E portion of the Joint Collaborative WMD Analysis.

US Ground Forces in Attack Analytical Support for the 1996 Counter Proliferation Front-End Assessment

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The 1996 Counterproliferation (CP) Front-End Assessment (FEA) was chartered to define and evaluate programmatic alternatives that meet CP requirements of the regional Commanders-in-Chief (CINCs). This presentation describes the US Ground Forces on Attack component of the CP FEA. This presentation describes the ground force assessment in terms of its NBC threats and scenarios, analytical framework, specific findings, and general conclusions. As in the Combined Arms in a Nuclear/Chemical Environment (CANE) series of tests, this assessment estimates overall force effectiveness, in this case for a US ground force attacked with chemical or biological weapons during a counter-offensive. For this measure, 100% means the chemical or biological weapons had no effect. Chemical and biological were treated as separate scenarios. The chemical scenario was one attack per US brigade. The biological scenario was one line source attack and one "leaker" missile attack per US corps. Both the on-and off-target effects were assessed as well as the effects of contaminated areas. The effects of these attacks are a function of the NBC defense equipment available in the US ground force. Individual brigades were considered either as having current NBC defense capabilities or "NBC modernized" capabilities. The number of "NBC modernized" brigades was based on the level of funding in the Joint NBC Defense Program. Three funding cases were considered: Current (i.e. zero out all NBC equipment for FY98 and beyond), POM (i.e. no cuts and no plus-ups), and 2 MRC (i.e. plus-up enough to "NBC modernize" the entire 2MRC force). The overall force effectiveness of the ground force was aggregated from the brigade's effectivenesses. Result for the chemical scenario: Current-62%, POM-70%, and 2MRC-99%. Result for biological scenario: Current-48%, POM-69%, and 2MRC-94%. Key capabilities and systems included rapid warning (JWARN), advanced biological detection (JPBDS, LRBDS), improved chemical detection (ACADA), and chemical detection on the move (LSCAD, LNBCRS). Important caveat: this assessment did not capture the indirect benefits to the ground force resulting from the Air force and Navy NBC modernization which is funded in the POM and 2MRC funding cases.

Counter Proliferation Front-End Assessment Bio Terrorism

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Approved abstract not available at printing.

Wednesday, 0830-1000
Composite Group III Session

Wednesday, 1330-1500
A Prototypical Expert System to Assist Army Chemical Officers in Passive Defense Recommendations

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The Army Chemical School has identified a need for a decision aid that will assist the unit chemical officer in planning passive defense measures and sustaining unit effectiveness through resulting NBC conditions without seriously detracting from unit operational readiness. This presentation presents a prototypical chemical officer decision aid in the form of an expert system which assists the chemical officer in making recommendations to the battlefield commander. The decision aid incorporates data from current information resources, such as the Theater Missile Defense Force Protection Tactical Operations Center. The input information includes, but is not limited to: weather, terrain, enemy situation, friendly situation, enemy capability, friendly mission (commander's intent), probability of an NBC attack, enemy doctrine, and friendly doctrine. The output of the decision aid is a prioritized list of recommended courses of action. Information concerning the courses of action includes: MOPP level, decontamination considerations, level of hardening, and a time-line to coordinate execution. A brief analysis of the Army passive defense system, justification for an expert system, and a demonstration of the prototype, written using the KAPPA-PC expert system shell, is also presented.

Fuzzy Expert Decision Making In Constructive Simulation (FEDICS)

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In recent years, significant progress has been made in the Department of Defense (DoD) to create a seamless synthetic environment for the purposes of acquisition, operational testing, and training and readiness. Command and control (CC) in Army simulation models such as ModSAF and IUSS is currently performed by a human operator or overly simplistic rules. The synthetic environment includes virtual, live, and constructive representations of a battlespace. Distributed interactive simulation (DIS) development has played a key role in development of interoperable simulations across all three representations. However, they lack the capability to represent command staffs and their communications.

In order to support the large-scale simulation exercises envisioned for the future in DoD, it is necessary to simulate the functions of command staffs for virtual forces. It is desirable to conduct simulations without the need for a team of people to issue lower-level orders and recommendations and operate the simulations and often prohibitively expensive and logistically cumbersome requirement in current simulations. The human operator constraint limits simulations to the extent that an experienced staff officer needs to be a part of the simulation. The simulations results are dictated by the experience of a particular commanders experience and command style. The range of simulation scenarios and their fidelity is severely limited when CC is accomplished via a very simple rule set.

The FEDICS tool is a developmental concept for a virtual NBC staff officer that represents the human aspects of command, control, and communications in entity-based virtual simulation. The FEDICS tool that we envision for this effort is designed to act as a U.S. Army NBC action officer. However, the methodologies and design principles employed are generically applicable to other conceptual command entities at different echelons.

The FEDICS tool will enable the Army to perform more realistic constructive simulations by implementing a fuzzy logic expert system as the CC entity. Because the FEDICS entity will entail the knowledge of many experienced NBC staff officers, constructive simulations employing FEDICS will be able to wargame a range of actions, without the staff officer actually being present.

We will simulate the NBC action officer. FEDICS will enable battle simulation in information-poor and information-overload environments. In addition, wargamers will be able to perturb (disrupt, add erroneous data, cut, etc.) FEDICS inputs. These fog of war capabilities enabled by FEDICS will give simulations much greater realism.

A Quick Response Approach to Assessing the Operational Performance of the XM93E1 NBCRS Through the Use of Modeling and Validation Testing.

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With a Milestone decision review just months away, the Army's XM93E1 nuclear, biological, and chemical reconnaissance system (NBCRS) received an operational assessment of "unsuitable and ineffective" because crew work load had reduced mission performance to unacceptable levels. The NBCRS product manager and Army Research Laboratory (ARL) researchers quickly responded by identifying work station design modifications which would reduce crew work load. The NBCRS test integration working group (TIWG) also responded with a unique operational assessment methodology which was quick, low cost, and allowed for a comprehensive assessment of the modified system. This method used ARL hardware versus manpower (HARDMAN) III modeling in conjunction with validation testing. Specifically, the manpower-based system evaluation (MAN-SEVAL) module of HARDMAN III was used to estimate soldier-in-the-loop system performance using mission simulations for both the standard NBCRS and the modified NBCRS. The model predicted that the design modifications improved mission performance time by 12%. With this indicator of success in hand and using the modeling to help focus the planned testing, the TIWG developed what was termed an "operational MANPRINT (manpower and personnel integration) validation" (OMV) test. The scope of the OMV methodology was well defined and concentrated on the key mission performance characteristics identified by the modeling effort. This model and validation test approach provided for a comprehensive operational assessment of the NBCRS with minimal funding and time requirements. The total time from initial model development to receipt of draft operational assessment was 5 months. Data collected during the OMV are being used by ARL to update and accredit the HARDMAN III model for future use by the Operational Evaluation Command in assessing planned NBCRS program improvement phases. This paper describes the benefits of using modeling and simulation (M&S) to support the operational assessment of a developmental system.

Wednesday, 1530-1700
Analysis of Joint Remote Detection and Early Warning Phase I: Ground Forces

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Approved abstract not available at printing.

Modeling the Impact of Vaccine Effectiveness Rates in Biological Defense

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Vaccination is the most cost-effective means of preventing disease and could play a significant role in defending US forces against hostile attack with biological warfare (BW) pathogens. This paper models the effect of vaccination as composed of two factors: How much the vaccine reduces vulnerability in protected individuals (here defined by the vaccine protection factor) and the percentage of the inoculated population that obtains protection (here defines as the vaccine's effectiveness rate). A vaccine's effectiveness rate could have important consequences for military units vaccinated against potential BW threat agents.

Estimated casualty percentages corresponding to specified dosages of a hypothetical pathogen and a hypothetical vaccine are developed using a lognormal dose-response relationship, as a function of vaccine protection factor, probit slope, and effectiveness rate. The sensitivity of casualty percentage to changes in vaccine protection factor and effectiveness rate is examined. In particular, when protection is defined in terms of maximum tolerable casualty percentage, an effectiveness rate of less than 100% can be shown to fix an upper bound to the dosage of pathogen a vaccine could protect against.

The analysis of effectiveness rate impact is applied to the viral agent Venezuelan equine encephalitis (VEE) to explore implications for US Army unit mission effectiveness and vaccine development goals. Various hypothetical vaccine protection factors and effectiveness rates are considered. Analysis is based upon estimates from atmospheric transport and diffusion, casualty estimation, and unit effectiveness models applied to a set of plausible attack scenarios.

A Mathematical Model for Extending BW Casualty Prediction to Secondary Contagious Effects

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The effects of a biological attack with live pathogens may be magnified by contagious transmission of disease from those initially infected. For example, *Yersina pestis* (the causative agent of plague) released in aerosol droplets of 1-10μ diameters is likely to produce primary cases of pneumonic plague, which is highly infectious and transmissible through direct human contact.

A model was developed for estimating the additional casualties from a single generation of contagious transmission of pneumonic plague subsequent to an attack with aerosolized *Yersina pestis*. A binomial transmission process was approximated by a Poisson expression combining contact rate and probability of transmission in a single contagion parameter. The resulting models was exercised for a range of values of the contagion parameter. The effect of a hypothetical vaccine was represented by reducing the contagion parameter to account for a lower contact rate (lower disease incidence in the population) and a lower probability of transmission from a single contact with an infected individual (due to vaccine protection). For a vaccine effectiveness rate of less than 100%, the vaccinated population was modeled as a mixture of vaccinated and unvaccinated individuals.

In this model, the prophylactic effect of a hypothetical vaccine that protects all inoculated individuals is shown to significantly reduce contagious casualties at relatively small protection factors. Protection from a hypothetical vaccine is contrasted with the effect of antibiotic therapy. Results are presented in terms of casualty percentage footprints for plausible attack scenarios and summary distributions of casualty area coverages across a sample of plausible attack scenarios.

Thursday, 0830-1000
KNOWLEDGE SHARING AND THE VIRTUAL ORGANIZATION: A U.S. Federal Agency's Approach to Restructuring to Meet 21st Century Challenges

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As organizations -- governments, industry, and academia -- move into the seamless, boundary-less 21st century, the value-added of individuals who are part of these organizations will be measured by their ability to share knowledge and expertise with others. Given the complexity and dynamics of the 21st century, if individuals cannot -- or will not -- share knowledge their value to organizations will be limited.

Much of knowledge sharing is cultural, and a very small part is technical. To this end, knowledge sharing is leadership-driven and technology-enabled. The goal is to create an environment where communication among knowledge workers can be accomplished across the traditional boundaries of time and space. The value of technology-enabled communication includes the ability to develop an organizational memory, rather than isolated pockets of expertise. The synergy of collaborative relationships produces a larger "whole" than mere aggregation of individual contributions.

This presentation will describe the complexity of how an organization makes this cultural shift. Last year, several organizations within the U.S. Department of Energy (DOE) began sharing technical personnel on a DOE Complex-wide basis. In addition, these traditionally isolated DOE sites began exchanging technical knowledge and expertise. The goal of this effort was to enhance DOE's ability to maintain and even strengthen the Agency's technical capability; and to break down the compartmentalization, isolation, and redundancy that was built into the DOE Complex during the Cold War. Overall, was the desire to enhance technical experience, expertise, and productivity through cross-functional synergies.

The genesis of the DOE knowledge sharing program began in the spring of 1995 in the face of mounting Congressional pressure to reduce the Agency's budget and changing missions. The concern among DOE leaders was that budget reductions -- while striving to make DOE more efficient -- would at the same time undermine the Agency's ability to meet enduring research and technical requirements of DOE programs.

This presentation focuses on the development of a knowledge sharing network from both a technical and organizational perspective; the underlying design principles behind creating such an organization; and the learning experiences to include transition from a design phase to an operational phase.

An Assessment of Using Radiological Sources for Access Denial

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Abstract not available at printing.

Hit-to-Kill Interceptor-Bulk Chemical Payload In Situ Negation

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Ensuring the defeat of a TBM bulk chemical payload involves more than simply rupturing the tank -- it also involves negation of the payload so that no more than a benign concentration ever makes it to the ground. It has been shown through sub-scale gun tests, full-scale sled tests, and flight tests that a bulk chemical payload tank is relatively easy to rupture with a hit-to-kill (HTK) interceptor. However, the response of the bulk payload fluid to the mechanical "insult" is not so clear. Unlike explosions in "infinite" or "semi-infinite" fluids (e.g., underwater explosions), where periodic and longer-term phenomena can manifest themselves, the timescales of a HTK event lasts only on the order of milliseconds before the high pressures and temperatures generated by the engagement rupture the payload tank and the fluid is expelled into the surrounding space. While the energy generated in the impact can easily be in the hundreds of megajoules, the processes that couple that energy into the fluid are not sufficiently understood. Knowledge of these processes is required to predict the rate of fluid expulsion, aerosolization, vaporization, and potential chemical changes which determine the source term required for input in transport and diffusion codes for ground effects predictions.

This paper examines energy considerations for intercepts of a HTK projectile with a bulk chemical payload. Various physical and chemical processes are discussed relative to their energy requirements and timescales. Relevant sub-scale and full-scale test results against TMD targets will be included. A better understanding of the physical processes that could be involved will provide for: 1) a rational approach to further lab-scale phenomenology testing, 2) a more intelligent choice of instruments for gathering lethality data, and 3) insight into the results of sophisticated numerical models.

Thursday, 1330-1500
Automated NBC Hazard Prediction Tools: Comments from the Field

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In September of 1996, the Joint Warning and Reporting Network-Prototype (JWARN-P) was delivered to European Command (EUCOM) and US Army Fifth Corps in Germany. JWARN-P was in response to a EUCOM request for an automated NBC Warning and Reporting System, and staff decision aid to be used by chemical staffs. It is an interim solution using several Government and Commercial off-the-shelf (GOTS, COTS) hazard prediction, warning and reporting, and database programs on laptop computers, meant to provide an initial operational capability until the developmental JWARN is fielded. This represented the first time that such a system had been placed in the hands of Soldiers, Sailors, Airmen and Marines to be used without the system developers close at hand except for initial new equipment training.

One stated purpose of the JWARN-P mission was to obtain user feedback that would be used to guide the developmental JWARN program. Particular points of interest were functionality, user interface, ease of use, and training, both for the actual equipment operators

and the staffs that interpret and present the results. This presentation covers a short description of the JWARN-P system, the initial user training, user feedback from EUCOM/ 5th CORPS, and recommendations on how this user feedback can be used to benefit the JWARN developmental program.

Utility of Detailed Hazard Predictions in an Operational Scenario: Results from 64th MORSS Working Session.

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During the 64th MORSS, Working Group 7, Nuclear, Biological and Chemical Defense, held a working session to discuss the utility of detailed NBC hazard predictions for operational use. As computing power increases, hazard prediction programs originally used in the Research and Development (R&D), and analysis realms can now be run on computing equipment that operational staffs have organic or can get access to. The question remains: Are these tools appropriate for operational use and under what circumstances?

Participants during the 64th MORSS working session included active duty, retired and Reserve military personnel; and model developers and analysts from both government and industry. Each brought their unique perspective into a lively discussion that raised several interesting points. We reached a consensus on several key points and concerns that the NBC community needs to remain aware of as we strive to provide ever more powerful automated tools to assist staffs and analysts.

This paper and presentation describes the conduct of the working session, our results, and concerns. Key topics of discussion included: best mix of detailed and simplified hazard prediction tools during planning and execution phases of military operations; how should the results be presented and interpreted; and training and staffing considerations for the use of sophisticated modeling tools.

Chemical Weapons Field Test Archive Database

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The objective of this task is to convert and host the Edgewood Research, Development and Engineering Center (ERDEC) chemical weapons field test data in an electronic format that will allow both the preservation and access to data on open air testing of CB agents. The Chemical Warfare/Chemical and Biological Defense Information Analysis Center (CBIAC) has begun to incorporate the information from these files into a database for dissemination, as appropriate, to authorized users. The database is hosted at the CBIAC on a SUN SPARC Server using a BASISPlus™ database platform. Authorized users can access the database via the World-Wide-Web. The database contains a search engine for locating information and will eventually contain full-text versions of all the documents referenced.

Thursday, 1530-1700
Technical and Economic Analysis Comparing Alternative Chemical Demiliterization Technologies to the Baseline

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The Army is investigating the possibility of implementing alternate chemical demilitarization technologies (to incineration) at Aberdeen Proving Ground, MD, and Newport Chemical Activity, IN, sites where agent is stored in bulk only containers. There are five alternate technologies (AT) under investigation; two under development by the Army and three from private vendors. AMSAA was tasked by the Project Manager for Alternative Technologies and Approaches, which is under the Program manager for Chemical Demilitarization, to conduct a Technical and Economic Comparison of the five alternative technologies with the baseline incineration program. Areas addressed in the study included process operability (technical characteristics), process capability (throughput), safety (worker and public), environmental permitting, cost, and schedule. Safety was evaluated relative to the impact on cost and schedule for design modifications. All technologies can be designed to operate safely. The study concludes that none of the ATs are as technically mature as incineration; however, all have the potential to successfully destroy the stockpile with comparable safety, and with costs and schedules comparable to, or less than incineration. All ATs have less permitting risk compared to incineration. Permitting risk, due to demonstrated negative public opinion, could significantly delay, or even prevent incineration from being permitted.

The Way Ahead - A Working Session

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This working session will be used to capture the final thoughts and comments of the Nuclear, Biological, Chemical Defense Working Group participants. In particular, we will discuss analysis trends and the future tools and techniques required to continue providing quality Analysis for Complex, Uncertain Times.

WG 8 — MOBILITY — Agenda
Chair: Mr. Denis Clements, JWARS Office, OSD, ODPA&E
Co-Chairs: Mr. Tom Denesia, USTRANSCOM/J5-AA
Mr. Frank McKie, USA, CAA/CSCA-MD
Mr. Dave Merrill, USAF, HQ AMC/XPY
LTC Jim Moore, USAF, AFIT
MAJ Steve Baker, USAF, USAFA
Advisor: Dr. Yupo Chan, USAF, AFIT
Room: MCA Conference Room, Diamond Hall - CR-1 and CR-2

Room: MCA Conference Room

Tuesday, 1030-1200
Multi-Modal Deployment Applications
Dr. Elizabeth Abbe; US Army Concepts Analysis Agency

Real Time Decision Tools for the Dynamic Commitment War Game Series for the Quadrennial Defense Review
LtCol Reed F. Hanson; US Air Force Air Mobility Command

Tuesday, 1330-1500
Strategic Mobility and Intratheater Logistics in JWARS
LTC John O. Yanaros Jr.; The JWARS Office

Summary of Movement Representation in Models and Simulations – Phase II
Ms. C. Denise Bullock; US Army Waterways Experimentation Station

Wednesday, 0830-1000
COMPOSITE GROUP III SESSION .... Ellis Hall

Room: Diamond Hall – CR-2

Wednesday, 1330-1500
Selective Transload as a Force Multiplier for Airlift (STAFMA)
Maj Thomas P. White, US Air Force Air Mobility Command

Air Mobility Express (AMX) Air Force Airlift Requirement
Mr. Jack R. Coley and Mr. Dana L. Hill; Dynamics Research Corporation

Room: Diamond Hall – CR-1

Wednesday, 1530-1700
Reception, Staging, Onward Movement, and Integration Study
Mr. Doug Baird, IDA

RSOI Analysis Emphasizing the Use of Army Watercraft
CPT Timothy Birkenbuel, Mr. G. Phil Raiford, Mrs. Veronica Crutches; Military Traffic Management Command - Transportation Engineering Activity

Room: Diamond Hall – CR-2

Thursday, 0830-1000
Contingency Aircraft Parking Planner
Mr. Robert B. Underwood, Mr. Phillip L. Doiron; Applied Research Associates Inc.

Modeling Integrated Logistics Support Operations for "Fighter Wing Equivalents" Through Dynamic Simulation
LTC Stephen R. Parker and Mr. Patrick M. Williams; US Army Concepts Analysis Agency

Thursday, 1330-1500
Mobility Assessment of Wheeled and Tracked Vehicles Using the Stochastic Mobility Model
Mr. Randolph A. Jones and Mr. John G. Green; US Army Waterways Experimentation Station

Assessment of Mobility Performance within CCTT SAFOR
Dr. Niki C. Deliman and Ms. Denise Bullock; US Army Waterways Experimentation Station

Thursday, 1530-1700
Working Group Business Session
Mr. Denis Clements, GRC International Inc.

WG — 8 Mobility — Abstracts

Tuesday, 6/10 1030-1200
Multi-Modal Deployment Applications

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The U.S. Army Concepts Agency (CAA) has developed the Global Deployment Analysis System 9GDAS), a high resolution, multi-modal entity model for the comprehensive simulation of end-to-end force deployment: CONUS/OCONUS origins to theater tactical assembly areas (TAAs). The model is incorporated within an expandable relational database.

GDAS is unique in its capability to distribute distinct types of cargo onto vehicles of multiple modes (e.g., road, rail, air, sea, pipeline, inland waterway) across an expandable global network with detailed facility structure. GDAS combines optimization techniques for effective selection of mode and route and assignment of vehicles with an objective of achieving timely deployment in combination with efficient use of resources.

This presentation will demonstrate the usefulness of incorporating scheduling logic within an expandable, end-to-end, multi-modal model structure. With focus on model capability to evaluate alternate modes, routes, and ports, demonstrations of decision support will include model selection of strategic lift (e.g., air rather than sea) dependent on intra-theater facility capability (e.g., road and rail handling support). The impact of interactions at the ports – e.g., simultaneous activity due to deployment and redeployment or exchange from strategic lift to inter-coastal sealift and intra-theater airlift – will be incorporated into the decision process. GDAS will be comported to a model with more traditional scheduling logic (TRANSMO) in achieving timely delivery under constrained vehicle resources.

Real Time Decision Tools for the Dynamic Commitment War Game Series for the Quadrennial Defense Review

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Dynamic Commitment is a series of force allocation games played by JCS, Services and War fighting CINCs to allocate US forces in a dynamic fashion for the time frames envisioned in the Joint Strategy Review and Joint Vision 2010. Insights from Dynamic Commitment are used in the Quadrennial Defense Review Process to help determine the impact of repeated high OPTEMPO/PERSTEMPO on the ability of the US to maintain the capability to fight and win a dual MRC. Real time tools were developed to delineate impacts PERSTEMPO, operational flexibility, and transportation feasibility for lift assets, by evaluating real time combinations of 45 different scenarios played in the Dynamic Commitment game. This discussion will describe the processes involved with evaluating forces structures and their flexibility and robustness in varying scenarios.

Tuesday, 6/10 1330-1500
Strategic Mobility and Intratheater Logistics in JWARS

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The Department of Defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

This briefing will address JM&SRG requirements, User Group defined scenarios/partitions/use-cases, and associated MOPs/MOEs that will shape the development of JWARS. Potential legacy models and functionality for reuse will be presented, derived through JWARS and other organizational workshops and website discussions. The presentation will conclude with a status update on the JWARS program. JWARS will include prepositioning, deployment of personnel, equipment, and supplies by air and sea, sustainment, infrastructure availability, redeployment and retrograde, and logistics: port operations distribution and tracking, pipelines, and major supply routes. Planning and command and control will be modeled. Mobility & Logistics will have a dynamic affect on the theater order of battle and sustainment.

Summary of Movement Representation in Models and Simulations – Phase II

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The Army Model and Simulation (M&S) Master Plan was established to outline the framework and process for standardizing Army M&S techniques, procedures, and development. This plan establishes standardization objectives within approximately twenty M&S standards categories which represent the M&S technical functions that, taken as a whole, cover the M&S technological spectrum. Standards category 'Battlefield Algorithms - Move' supports an Army M&S main objective - Provide authoritative representations of systems. The Move category addresses the objects, algorithms, data and techniques necessary to replicate activities that influence land force platform and personnel movement (ground, air, and water). It also addresses mobility/countermobility, suppression, formations, and dispersion. The Move category is chaired by Mr. James H. Robinson of the U.S. Army Engineer Waterways Experiment Station (WES) and is supported by representatives from various Army agencies throughout the M&S community.

The Army Model Improvement Program (AMIP) directs project funding of work that builds toward M&S standardization objectives within the standards categories. Funding is based on to what degree each proposal will significantly contribute to promoting standardization within their respective standards categories. Two AMIP-funded studies, within the purview of the Move standards category, have been conducted by the Army Materiel Systems Analysis Activity and WES, which investigated algorithms used to depict battlefield movement in selected Army M&S. The studies addressed each objective for battlefield movement discussed above and provided the M&S community a reference document for movement algorithms. The findings of the investigation will be discussed in this presentation.

Wednesday, 6/11 1330-1500
Selective Transload as a Force Multiplier for Airlift (STAFMA)

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The current paradigm for strategic airlift involves single handling cargo. Cargo is loaded on an aircraft at an aerial port of embarkation (APOE) and supported through the enroute bases or aerial refueling to a final offload at an aerial port of debarkation (APOD). An alternative concept of operations in which cargo is transferred from one aircraft type to another at selected enroute stops is explored using network simulation. This concept is applied to evaluate the capability to deliver cargo to Northeast Asia using existing air mobility assets and infrastructure. Advantages of this concept are discussed and key sensitivities are addressed.

Air Mobility Express (AMX) Air Force Airlift Requirement

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The Air Force commissioned Dynamics Research Corporation (DRC) to determine the daily airlift requirements is support of the Air Mobility Express concept. The Air Force required this study as a critical input to the Air Mobility command's refined concept of operations and request for proposal for Air mobility Express (AMX), an express cargo system to move high value, high priority, small packages from the consignors to a central hub for sorting and subsequent delivery to the theater of operations. DRC's effort was a four-step process: 1) Determine the commodities most likely to be shipped by AMX; 2) Establish daily wartime consumption rates for those core commodities; 3) Compute the daily AMX weight and cube requirements; 4) conduct capability assessments to determine the impact of AMX on theater aircraft availability. For the purpose of this study, spares eligible for AMX airlift support were significantly broadened to take on a proactive stance in support of a Lean Logistics, Two-level maintenance environment. In this regard we defined warstopper as those reparable and consumable spare parts and aircraft engines whose failure would directly impact the ability to launch an aircraft. We then refined this definition of warstopper into four distinct categories of spare parts that were included in the sizing effort. Using our definitions of warstopper, we computed AMX airlift requirements for three scenarios: Major Regional Contingency (MRC) East, MRC West, and two near-simultaneous MRCs.

<u>Wednesday, 6/11 1530-1700</u>
Reception, Staging, Onward Movement, and Integration Study

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This study proposes specific changes to joint, Service, and combined doctrine; organizational structure; and automated planning and reporting systems necessary to more effectively and efficiently conduct joint Reception, Staging, Onward Movement, and Integration (RSOI) in any geographic combatant command's area of responsibility (AOR). An analysis of existing joint, Service, and combined doctrine determined that there is very limited doctrine relating to joint RSOI processes. This study makes specific recommendations for changes to, or the creation of new, doctrine. An analysis of theater organizational structure determined that current structure for conducting RSOI and theater LOC operations is fragmented and duplicative among the Services. This study offers several options which could enhance a combatant command's ability to conduct RSOI operations. This study also examined existing, and developing, automated planning and reporting systems and recommends changes or modifications to these systems that could enable combatant commands to plan and conduct RSOI operations more effectively.

RSOI Analysis Emphasizing the Use of Army Watercraft

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Approve abstract not available at printing.

Thursday, 6/12 0830-1000

Contingency Aircraft Parking Planner

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Determining the suitability of airfields is one of the first steps required when planning operations throughout the world. Air Mobility Command (AMC) currently uses varied information sources and relies on manual manipulation of airfield diagrams, imagery, and databases to determine the numbers and types of aircraft that can operate out of a given airfield. The present manual process takes days and sometimes weeks to do the optimum aircraft bed down plan.

Applied Research Associates, Inc. (ARA) was tasked by the AMC to develop a software package that plans the bed down of aircraft. This software package, the Contingency Aircraft Parking Planner (CAPP), has the capability to input the diagram of an airfield, including runways, taxiways, and ramps. CAPP transforms airfield diagrams or aerial photography into a scaled plan view. Once this diagram is in the system, the user can identify ramp and taxiway areas, as well as the type of aircraft that will use the airfield. The software then calculates an optimal parking plan and displays the exact parking spots and taxiway lines for the various types of aircraft. The software operates on a PC under Windows 95.

This presentation will describe the present capabilities of the CAPP, as well as, future enhancements being developed.

Modeling Integrated Logistics Support Operations for "Fighter Wing Equivalents" Through Dynamic Simulation

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A unique approach is developed for analyzing the balance between supply versus demand in evaluating logistics requirements of the armed forces of the United States. With this approach new ways of measuring combat readiness and logistics support are proposed and available to ensure that the armed forces remain ready to fight during the projected defense draw down beyond the year 2000.

The development of this analysis methodology was established as an alternative approach to answer the never ending question of whether or not the Air Force can maintain logistics to support strategies of force as claimed during the recent Deep Attack weapons Mix Study (DAWMS).

The contribution of this research is a prescribed method to evaluate the steady-state logistics flow of fuel and ammunition through time. This will allow the analyst to evaluate various resource strategies, constantly evaluating bottlenecks, and inconsistencies with the logistics flow process. This modeling effort serves as a Simulator to model steady-state logistics flow and as an Output Processor to evaluate and verify TACWAR results.

Mobility Assessment of Wheeled and Tracked Vehicles Using the Stochastic Mobility Model

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A study was conducted in which the mobility performed of three wheeled (HMMWV, LAV25, and LSV) and three tracked (M1A1, M2A2, AND AAAV) vehicles was evaluated on selected terrain in the Philippines, South Korea, and Saudi Arabia/Kuwait using a sub-model of the NATO Reference Mobility Model (NRMM) known as the Stochastic Mobility Model. The purpose of this study was to develop and evaluate new methodologies and assist in assessing/developing new vehicle systems in selected regions of the world where deployment would possible take place. Speed profiles and reasons for limited mobility of each vehicle were determined by performing 100 iterations per terrain unit while simultaneously varying input terrain parameters using a uniform distribution. This study establishes an analytical technique to evaluate terrain effects on vehicle design and performance; identifies mobility differences between wheeled and tracked vehicles; identifies those terrain features that impede vehicle mobility for different missions; identifies strengths and weaknesses in different vehicle designs; and offers an analytical tool to evaluate mechanical changes to current and future vehicle systems.

Assessment of Mobility Performance within CCTT SAFOR

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Realistic mobility representation and movement behaviors are crucial issues for the Close Combat Tactical Trainer (CCTT). The mobility representation within CCTT Semi-Automated Forces (SAFOR) is based on relationships employed by the NATO Reference Mobility Model (NRMM) modified to meet constraints such as data requirements and run-time. The NRMM is a detailed model which incorporates vehicle, terrain, and scenario parameters to determine vehicle speed in an area; it was identified by the Army Model and simulation Office Standards Category MOVE as the recommended standard model for vehicle movement in the constructive environment. In NRMM, the input data for environmental features is utilized directly, resulting in an infinite number of possible data sets. The CCTT SAFOR mobility model clusters environmental feature input data into a manageable subset of categories based on ranges in values. Since correlation between constructive and virtual environments is crucial, a systematic analysis comparing the mobility performance of CCTT SAFOR to NRMM results is being conducted to evaluate the impact of clustering data into the currently used categories. Measures of performance (MOPs) include vehicle speed predictions, percentages of severely restricted areas, and speed controlling factors. Measures of effectiveness will be derived from MOPs. Both tracked and wheeled vehicle configurations will be assessed over a variety of regions. Sensitivity analysis and designed experiments will be used to evaluate differences in model results. The purpose of this presentation is to present the methodology employed and emerging results.

WG 9 - AIR WARFARE –Agenda
Chair: Mr. Thomas M. Lillis, McDonnell Douglas Aerospace
CoChair: Lt Rob Renfro, NAIC/TAAE
CoChair: Lt. Col. Marty Allen, AFSAA/SAG
Advisor: Mr. David E. Spencer, RAND
Room: MCRC – CR-164, Diamond Hall – CR-1 and CR-2

Room: MCRC – CR-164

Tuesday, 1030-1200
Joint Scenarios for Land, Littoral and Airwarfare
Ms. Cindy J. Noble, TRADOC Analysis Center

Air Warfare in JWARS
Lt. Col. John O. Yanaros, Office of the Secretary of Defense (PA&E)

Joint Anti-Armor Special Study Item Level Performance Analysis
Mr. Ronald Thompson, U. S. Army Material Systems Analysis Activity

Tuesday, 1330-1500
Airpower in Korea: OPLAN 5027 Campaign Analysis
Maj. Russell D. Hodgkins, Air Force Studies and Analyses Agency

F-22 Comprehensive Analyses
Lt. Col. William B. McClure, Air Force Studies and Analyses Agency

Evaluating the Contribution of GPS-aided Weapon Systems on the Battlefield
Lt. Michael A. Morell, GPS Joint Program Office

Wednesday, 0830-1000
COMPOSITE GROUP III SESSION .... Ellis Hall

Room: Diamond Hall – CR-1

Wednesday, 1330-1500
New Challenges in Air Defense Systems Analysis
Mr. Stephen Hogue, U.S. Army Material Analysis Activity

Battle of Khafji: Improved Modeling and Simulation of Air and Ground Force Interactions
Maj. Daniel R. Clevenger, Air Force Studies and Analyses Agency

Room: Diamond Hall – CR-2

Wednesday, 1530-1700
Interceptor Threats to High Value Assets
Mr. Tim Kanoy, NAIC/TAAE

Helmet-Mounted Cueing Systems
Lt. Laura E. Durr, NAIC/TAEI

Simulated Air Combat Evaluation of the Su-27 vs F/A-18
Lt. Joe Mason

Room: Diamond Hall – CR-1

Thursday, 0830-1000
TACTOOL: A graphical user interface for BRAWLER users
Mr. James T. Wicker, NAIC/TAAE

Hybrid Genetic Algorithm and Neural Networks for Model Consistency
Mr. Clark Dorman, System Simulation Solutions, Inc

Air Combat Analysis Evaluating the Emerging Threat
Mr. Scott F. Semmelmayer, McDonnell Douglas Aerospace

Thursday, 1330-1500
Foreign Integrated Air Defense Systems Intelligence Analysis and Production
Mr. David Panson, NAIC/GTI

Modeling Integrated Logistics Support Operations for "Fighter Wing Equivalents" Through Dynamic Simulation
Lt. Col. Stephen R. Parker, Department of the Army

Joint Suppression of Enemy Air Defense (JSEAD) - Problems and Possibilities
Mr. Cy Holliday, ASI - Systems International

WG 9 - AIR WARFARE - Abstracts

Tuesday, 1030-1200
Joint Scenarios for Land, Littoral and Airwarfare

Ms. Cindy J. Noble, Operations Research Analyst
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Uncertain times and decreasing resources are creating more and more joint efforts among the services. These efforts include analytic tools such as JWARS. The Army's TRADOC Analysis Center (TRAC) is starting now in developing robust joint scenarios to support future efforts. TRAC has performed Army analyses in a joint context For numerous years. Recent efforts include the development of robust joint warfare scenarios as they support deep strike and maneuver warfare. These scenarios will incorporate deep strike, interdiction, close air support, SEAD, theater air defense as provided by naval and ground forces, amphibious operations, maneuver warfare, surveillance, reconnaissance, joint communications, support operations and coalition forces in order to analyze our capabilities in defeating threats. These scenarios incorporate smart munitions, theater missile defense attack operations and a detailed review of deployment capabilities. These scenarios provide a tool for analyzing numerous capabilities in a joint context.

Air Warfare in JWARS

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The Department of Defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development and defense establishent force structure and readiness assessments. In the post-Cold War envirornment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object-oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System. This briefing will address JM&SRG requirements, User Group defined scenarios/partitions/usecases, and associated MOPs/MOEs that will shape the development of JWARS. Potential lagacy models and functionalities for reuse will be presented, derived through JWARS workshops and website discussions. JWARS is required to address studies related to Operations Plans development and assessment, force structure sufficiency - now and in the acquisition outyears, and analysis of alternatives. Through a C4ISR baseline, innovative operational concepts and alternative organizations may be investigated.

Joint Anti-Armor Special Study Item Level Performance Analysis

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A Joint Staff Special Study Team was formed to look at anti-armor munitions across the services and to provide a recommendation for the optimum mix in the post-2005 timeframe. In support of that effort, AMSAA conducted an Item Level Performance Analysis. The AMSAA analysis provided the effectiveness of 29 joint service munitions (Armor, Artillery, Fixed and Rotary Wing Aviation, and Infantry) against a comprehensive set of armored targets. Integration, analysis of results and findings (which built on the AMSAA Near [2005] and Far Term [2015] Anti-Armor Resource Requirement (A2R2) Item Level Performance Analyses) were also provided. The primary measure of effectiveness was probability of mobility or firepower kill, per munition fired, as a funcion of range. For direct fire systems, accuracy from a stationary firing platform to a stationary target was used as representative. Surface indirect fire system and aircraft sensor fuzed weapon effectiveness was based on a volley of twelve submunitions vs companies of thirteen moving tanks, thirteen moving BMP and a battery of 6 stationary howitzers. The number of kills in the array divided by the twelve munitions fired is the munition probability if kill vs the target. That probability is then used in the comparisons of direct and indirect fire systems.

Tuesday, 1330-1500
Airpower in Korea: OPLAN 5027 Campaign Analysis

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The governing plan for Combined operations in Korea is OPLAN 5027. AFSAA, in coordination with 7th Air Force and HQ Pacific Air Force, analyzed the OPLAN to gain insights into the contributions Airpower makes toward achieving the goals of the Combined Forces Commander. This study was conducted with the THUNDER campaign model. Several key areas of emphasis were:

- The potential impact of hardened NK airfield facilities on air superiority
- The potential impact of Theater Ballistic Missiles (TBM)
- The potential success/failure of interdiction of NK follow-on forces
- The potential success/failure of Allied counter-artillery fires
- The potential success/failure of inderdiction of NK supplies and logistics
- The potential impacts of NK Special Operations Forces (SOF)

The analysis was done with 1996 forces and current intelligence estimates. Potential impacts of adjusted force arrival flow were examined in a scenario where Korea was the second of two near simultaneous major regional contingencies.

F-22 Comprehensive Analyses

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The purpose of the F-22 Comprehensive Analyses was to thoroughly examined F-22 operational and cost effectiveness from a wide range of analytical perspectives. The object was to build a one source database of F-22 information and the analytic framework to address potential F-22 questions in a quick-turn fashion. These analyses were designed to answer the following questions:

What are force structure implications of the F-22?
How does the F-22 force impact the campaign?
How does the F-22 impact strike mission effectiveness?
How well does the F-22 counter current and emerging threats?

The Force Application Division of Air Force Studies and Analyses Agency (AFSAA) used the three highest levels of the modeling hierarchy, engagement, mission, and campaign analysis along with mobility and force structure analysis to do a complete assessment.

Evaluating the Contribution of GPS-aided Weapon Systems on the Battlefield

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Abstract not available at printing.

Wednesday, 0830-1000
COMPOSITE GROUP III SESSION

Wednesday, 1330-1500
New Challenges in Air Defense Systems Analysis

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The air defense mission has been enlarged in recent times to include defense against Tactical Ballistic Missiles (TBM). This mission brings new challenges to the analysis community. Modern radars for TBM defense, such as those used by THAAD and PATRIOT, are developing the flexibility to maximize system performance by choosing specific surveillance parameters for each deployment site and for the specific threats to defended areas around that site. Old Measures Of Performance, such as the detection range against specific targets, lose their meaning. Detection performance is still a function of the target's signature characteristics, but the frame rate for surveillance volume search, the type of signal the radar will use in its search, and the percent of available energy used in each volume are all functions of the threat, the requirements of the specific site, inte rcepter performance, and the desired fire doctrine. System's analysts attempting to make assessments concerning the performance of various systems against TBM's on new battlefields must have a method to estimate the surveillance performance of the radars under consideration. This paper will highlight a methodology developed at the Army Material Systems Analysis Activity which performs the needed tradeoffs to determine surveillance performance. Examples of the sensitivity of surveillance performance to changes in threats, site requirements and intercepter performance will be discussed along with the methodology.

Battle of Khafji: Improved Modeling and Simulation of Air and Ground Force Interactions

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The impact of air power strikes on advancing enemy ground forces is of great importance to national defense strategies. Many recent studies and wargames highlight the sensitivity of advance rates to the assigned impact of air power strikes. It should be intuitively obvious that the advance rates of ground forces should be related inversely to the air power strike impact assigned. This study is an effort to create a reuseable M&S tool set to analyse various interactions between advancing ground forces and various air power assets. A particular DESERT STORM battle was chosen as a historical reference setting and baseline for this study. During the Battle of Khafji a significant air interdiction effort was mounted against fairly well equipped and combat ready divisions. At the time of the battle these forces had not been significantly attrited, nor had the lack of supplies become a serious problem for them yet. Therefore, this battle provides a historical example of air power interdiction against relatively fresh and fairly well equipped troops. This study is focused at the mission or raid level. SABSEL, Enhanced Surface-to-Air Missile Simulation (ESAMS) and RADGUNS information is used for the one-on-one weapon-to-vehicle engagements. Simulated Warfare Environment Generator (SWEG) is an object-oriented mission-level simulation with current Distributed Interactive Simulation (DIS) capability and developing High Level Architecture (HLA) capability. Information from Field Manuals, intelligence sources, and other relevant sources was used to create the objects. An effort is also planned to aggregate various results from the mission-level for use at the campaign-level.

Wednesday, 1530-1700

Interceptor Threats to High Value Assets

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Abstract not available at printing.

Helmet-Mounted Cueing Systems

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This briefing looks worldwide at the use and development of helmet mounted cueing systems in air-to-air engagements. The briefing will look at the technology level in operational helmets and those in development in terms of capability, display symbology, de-clutter modes, and safety; their advantages, trade offs, and proliferation. The advantages of the helmet mounted cueing systems in WVR engagements are displayed in terms of first launch opportunities, additional launch opportunities, and exclusive launch zones. These advantages are quantified with a comparison of reduced time to trigger and exchange ratio for pilots with and without helmet cueing systems. We'll then discuss the trade offs in terms of weight, operations in a high-g environment, pointing accuracy, reliability, and problems that need to be overcome. Most importantly, we'll discuss the impact of the helmet cueing system on training and tactics and show that the helmet mounted cueing system alone is not a substitute for training or tactics. The briefing will look at typical costs of helmet cueing systems along with requirements and cost to interface with new, upgraded, and hybrid aircraft. The briefing concludes with a look at the countries using helmet mounted cueing systems, those developing the systems, and the expected proliferation of these systems.

Simulated Air Combat Evaluation of the Su-27 vs F/A-18

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Abstract not available at printing.

Thursday, 0830-1000

TACTOOL: A graphical user interface for BRAWLER users

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McDonnell Douglas Aerospace, under contract from NAIC/TAAE, is developing a graphical user interface to facilitate setting up simulated aerial engagements in BRAWLER. This GUI, known as "TacTool" will allow a novice user to create the input routines graphically. Currently, the user gives all input to BRAWLER through a series of batch files that he must edit. To set up an engagement scenario may take from several hours to several days depending on the complexity. TacTool eliminates the need to write the multitude of individual files because the user can piece together visually Red, Gray, and Blue tactics and the GUI will output the parameters in the form of BRAWLER formatted input files. TacTool is a menu-driven interface which allows the user to specify different scenario parameters including size and type of flights, initial conditions, commit and merge ranges, maneuver parameters, and wingman parameters. It allows the user to build almost any complex Red, Grey, or Blue maneuver. Once the scenario is complete, TacTool will display a picture of the profile each flight will be flying prior to writing the parameters to the SCNRIO and PRDATA files. TacTool incorporates the latest Red/Gray rules set which NAIC/TAAE and MACAIR have developed and enables the user to set-up complex Red tactics simply by selecting them from a pull down menu. The current version of TacTool is for use on the SGI workstation using BRAWLER version 6.2. Plans are in the working for a BRAWLER 6.3 edition. Future capabilities of TacTool will include ground controlled intercept tactics and AWACS intercept tactics.

Hybrid Genetic Algorithm and Neural Networks for Model Consistency

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Campaign air warfare models require many input parameters. Some of these come from higher resolution models, but the process of making the results consistent between the high and low resolution models may be difficult because of differences in modeling assumptions and implementations. In addition, traditional search methods may be difficult to use because of the long run time of campaign models. In this paper, we present a hybrid Genetic Algorithm and Neural Network approach to improve the consistency between models. Specifically, we improve the consistency between the air-to-air combat results between THUNDER and a higher resolution model using the hybrid approach. Genetic algorithms have been used in a variety of non-linear search contexts and have shown great power to find populations of good solutions. However, these contexts have traditionally been in situations where the evaluation of the GA individuals is easy. In large simulations, the evaluation function can take considerable time due to long run time models. In this paper we present the use of a Neural Network to model the evaluation of the individuals; since the evaluation time of the neural network is small compared to THUNDER, the GA/NN total performance as a function of time is greatly improved. In addition, since the NN learns the input/output relationship between the trained variables, it may be possible to use the NN as an interpolator or response surface tool for the variables of interest.

Air Combat Analysis Evaluating the Emerging Threat

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Analysis of new capabilities in air combat is often hindered by applying old concepts of operation. The analyst who is prejudiced by personal experiences will often overlook the potential of a new technology because he is unable (or unwilling) to try new and unconventional tactics. While human influences limit the scope of a study, computers have no such inherent biases and are more than willing to try anything, no matter how ridiculous the idea may seem. This study attempts to link the wisdom of analyst experience with the power of analytic tools through the use of an optimization tool known as a genetic algorithm. The genetic algorithm applies many of the laws of nature to "evolve" an optimum solution from a random set of potential solutions. In this case, new air threat capabilities are being tactics-optimized against current US systems, and the US systems are then counter-optimized against the threats. Results from the study show a strong dependence on Measures of Merit, and the genetic algorithm approach demonstrated the ability to quickly re-optimize tactics for changing mission objectives.

Thursday, 1330-1500
Foreign Integrated Air Defense Systems Intelligence Analysis and Production

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This presentation will discuss the new DoD IADS Support Program (DODISP) and how a new team has been formed to pool resources from several organizations to conduct IADS intelligence analysis and production. This approach eliminates redundency and allows for a single point of contact for foreign "big picture" IADS intelligence, namely NAIC/GTI. To further help stretch resources NAIC/GTI is pioneering a new virtual production effort to bring the various team members together in a virtual environment to facilitate intelligence production electronically. IADS products are becoming paperless with a push toward total visualization techniques to illustrate the IADS, using point and click techniques to bring up details. Visualization will go hand in hand with modeling and simulation efforts beginning to take shape in GTI. Modeling and simulation will play a key role in the analysis of foreign IADS. NAIC hopes to leverage off existing simulation tools with wide community acceptance as well as developing any new tools that are required. Simulations may include integrating existing proven models into the simulation. Eventually NAIC hopes to have a completely interactive IADS simulation/visualization. The user will be able to play as an interactive participant at any point in the IADS. This could be from a pilot's point of view inside the cockpit as he flys into an enemy IADS, to a radar operator on the ground watching his radar scope. Modeling and simulation techniques wil have to be flexible enough so that any type of IADS can be modeled quickly, since it will be unrealistic to have an IADS model on the shelf for every country. As new IADS technologies evolve the simulation will also have to be able to adapt in order to provide accurate representations. We also hope to also use our IADS models as customer products that can be combined and used with the customers' own models and simulations where threat IADS modeling is required.

Modeling Integrated Logistics Support Operations for "Fighter Wing Equivalents" Through Dynamic Simulation

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A unique approach is developed for analyzing the balance between supply versus demand in evaluating logistics requirements of the armed forces of the United States. With this approach new ways of measuring combat readiness and logistics support are proposed and available to ensure that the armed forces remain ready to fight during the projected defense draw down beyond the year 2000. The development of this analysis methodology was established as an alternative approach to answer the never ending question of whether or not the Air Force can maintain logistics to support strategies of force as claimed during the recent Deep Attack Weapons Mix Study (DAWMS). The contribution of this research is a prescribed method for the strategic analyst to develop an influence diagram which can be used to analyze logistics requirements to project and evaluate force capabilities. Additionally important to this modeling effort is a prescribed method to evaluate the steady-state logistics flow of fuel and ammunition through time. This will allow the analyst to evaluate various resource strategies, constantly evaluating bottlenecks, and inconsistencies with the logistics flow process. This modeling effort serves as a Simulator to model steady-state logistics flow and as an Output Processor to evaluate and verify TACWAR results.

Joint Suppression of Enemy Air Defense (JSEAD) - Problems and Possibilities

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Abstract not available at printing.

WG - 10 LAND WARFARE - Agenda
Chair: Mr. Thomas J. Iten, Raytheon, E-Systems
Cochair: Major Dennis B. Boykin IV, TRADOC Analysis Center
Cochair: Dr. Ephraim Martin IV, Lockheed Martin
Cochair: Mr. David Long, TRADOC Analysis Center
Advisor: Mr. Larry Cantwell,, TRADOC Analysis Center
Room: MCRC – CR-165, C&SC – CR-225

Room: MCRC – CR-165

Tuesday, 1030-1200
Minefield Tracking System for Operation Joint Endeavor
Mr. Burhman Q. Gates, Jr., USAE Waterways Experiment Station

Protection of Deployed Forces from Terrorist Attack
Ms. Pamela G. Kinnebrew, Mr. William L. Huff, USAE Waterways Experiment Station

Patton or Dantzig or Both?
CPT Brad Westergren, University of Texas at Arlington, Mr. Don Chappell, Lockheed Martin Vought Systems

Tuesday, 1330-1500
Envisioning Warfare in 2020 - The Army After Next
COL Stephen J. Kirin, Dr. Michael C. Ingram, TRADOC Analysis Center

A Wargame Architecture for Investigating Future Forces -The Army After Next Simulation Architecture
COL Stephen J. Kirin, MAJ Dennis B. Boykin IV, TRADOC Analysis Center

Wednesday, 0830-1000
COMPOSITE GROUP III SESSION .... Ellis Hall

Room: C&SC – CR-225

Wednesday1030-1200
Land Warfare Representation in the Joint Warfare System
LTC Terry W. Prosser, JWARS Office, OSD, PA&E

The Advanced Regional Exploratory System (ARES)
Mr. Wallace W. Chandler, U.S. Army Concepts Analysis Agency

Wednesday, 1330-1500
The Tail and the Dog: Logistics and Combat Modeling with a Purpose
Mr. James L. Stover, Raytheon E-Systems

The Logistics Anchor Desk - Supporting the CINC's Campaign Plan
Mr. Hugh M. Denny, Ms. Patricia Jones, U.S. Army Research Laboratory

Wednesday, 1530-1700
Modeling Attack Aviation Operations Using DIS
Mr. William J. Krondak, Mr. Randall Ramsey, CPT Stephen Yost, TRADOC Analysis Center

Joint Scenarios for Land, Littoral, and Air Warfare
Ms. Cindy Noble, TRADOC Analysis Center

Implementation of Close Combat Tactical Trainer (CCTT) Semi-Automated Forces (SAF) Combat Instruction Sets in Modular Semi-Automated Forces (MODSAF)
Ms. Marita Smith, Mr. Curtis Bottom, TRADOC Analysis Center

Thursday, 0830-1000
Modeling Combat Vehicle Misidentification in Simulations
Mr. John Mazz, Mr. Frederick M. Campbell, U.S. Army Materiel Systems Analysis Activity

The Personnel Attrition Rate (PAR) Series of Studies: Focus on the Relations Between the Incident of Psychiatric Casualties and Wounded in Action
Dr. Robert L Helmbold, U.S. Army Concepts Analysis Agency

Can the U.S. Prepare for the Next Peer Competitor?
Dr. Alan Goldman, Mr. Gerald A. Halbert, National Ground Intelligence Center

Thursday, 1330-1500
Some Considerations On The Application Of Soft Factors In Models and Simulations
Mr. Gerald A. Halbert, Mr. Stephen P. Ketterer, Mr. John R. Lynch, National Ground Intelligence Center

Objective Force Planning
LTC Martemas Arnwine, U.S. Army Concepts Analysis Agency

Power Projection in the 21st Century: Forces and Concepts
Mr. Louis R. Moore III, RAND

Thursday, 1530-1700
Combat MOE's in Relationship to Historical Evidence
Mr. Walter J. Bauman, U.S. Army Concepts Analysis Agency

Expeditionary Warfare Threat Environment Projections
Mr. Benjamin Wong, Marine Corps Intelligence Activity

Rapid Force Projection Initiative C3 Architecture Study
Mr. Chauncy McKearn, Hughes Aircraft Company

WG 10 - LAND WARFARE - Abstracts

Tuesday, 1030-1200
Minefield Tracking System for Operation Joint Endeavor

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Operation Joint Endeavor has emphasized a requirement for techniques by which minefields could not only be tracked by location and status, but also by descriptive attributes displayed on an Arc Digitized Raster Graphic background, provided by the Terrain Evaluation Module. The Engineering-Operations (E-OPS) software was developed by the U.S. Corps of Engineers to provide engineer force-level information and command and control. The U.S. Army Waterways Experiment Station was developed to provide customizable attributes, reporting, attribute-based querying, and geographic-based querying. The system provides additional capabilities such as storage and viewing of digitized photographs, hypertext information, plotting to scale, and export capabilities to distribute the minefield information throughout the force. This presentation will include a live demonstration of the E-OPS software.

Protection of Deployed Forces from Terrorist Attack

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Recent experience has shown that the demand for military engineering in support of antiterrorism has risen dramatically as the Army is drawn into a succession of operations other than war where protective facilities are not available. The USAE Waterways Experiment Station is developing an Antiterrorism Planner (AT Planner) to assist the engineer officer in planning and implementing the protective measures required for force protection. The AT Planner will be a Windows-based application suitable for operation on a notebook computer by combat engineer officers. Military engineers provide assistance in the design, construction, and assessment of protective structures for military facilities worldwide and may construct permanent or temporary antiterrorist measures for protection of U.S. forces. They may also provide training on these activities through the use of mobile training teams. Engineers now need rapid, doctrinally and technically sound methods and tools for worldwide use in fulfilling their antiterrorism missions.

The AT Planner will provide the engineer officer a computerized procedure for survivability analysis based on threat scenarios, tactics, and weapons systems. The threat conditions dictate a number of security measures that the engineer should consider. These measures are cumulative from the lowest to the highest threat level and are presented in the AT Planner in a concise and user-friendly format. The system calculates blast damage to structures and the construction time and resources required to enhance survivability. The AT Planner will provide engineers a critically needed analytical capability for fulfilling their antiterrorism missions.

Patton or Dantzig or Both?

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Army Vision 2010 calls for the Army After Next "to fight dispersed with extraordinary ferocity and synchronization" in part by capitalizing on emerging technologies. In addition to incorporating significant improvements in the traditional tank and automotive fields, the Army's future ground combat vehicles will exploit improved sensor, signature, management, communications and information systems. Frequently, early design trades seem to be based on the volume of the proponents' voices which result in false starts and considerable stress among team members. A common, mutually agreed upon basic systems integration tool is needed. We present TRADES, the Tactical vehicle Requirements Analysis and decision Evaluation System. TRADES exploits established mathematical programming techniques and other traditional Operations Research tools to facilitate management and user insight to the design process and to promote improved communications between parties addressing the systems integration challenge. Using our preliminary IRAD work on the Future Combat System (FCS) as an example, we review the process of:

- describing candidate subsystems and components for potential inclusion,
- developing binding and non-binding (goal) constraints to reflect combat effectiveness, sustainability, deployability, and program management requirements, and
- generating objective functions to address critical design issues (e.g. AOA, trade sensitivities).

We include a brief discussion of how we have used TRADES to support our decision makers in the FCS and other ground combat vehicle programs (e.g., FSCV and FIFV), and close with some ideas on evolving TRADES to accommodate greater granularity and detail in both the subsystems and the requirements as the ground combat vehicle programs mature.

Tuesday, 1330-1500
Envisioning Warfare in 2020 - The Army After Next

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The Army After Next (AAN) program was chartered to project a vision of future military operations out to about the year 2025. The program includes an annual cycle of events to identify and address issues associated with developing and fielding future forces. The

key event in the cycle is the Winter Wargame, a policy/strategy level game set in the year 2020 to raise such issues through player discussions and the employment of notional future forces. The U.S. Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC) served as the lead analytic agency for the Winter Wargame, integrating strategic and operational level insights; TRAC also orchestrated a multi-phased Tactical Wargame to provide insights for adjudicating game play at the Winter Wargame. This presentation summarizes the integration process and key analytic insights derived from the principal FY 97 AAN events.

A Wargame Architecture for Investigating Future Forces -The Army After Next Simulation Architecture

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Abstract not available at printing.

<u>*Wednesday, 0830-1000*</u>
Land Warfare Representation in the Joint Warfare System

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The department of defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

Land warfare is an area of primary focus in the JWARS project. Areas of interest include movement, doctrine and tactics, including maneuver warfare, engagements and attrition, and the impact of information operations on battle outcomes. This presentation will discuss the land warfare representations in the JWARS testbed and the lessons learned in developing the testbed. A portion of the testbed discussion will deal with representations of perception vs. ground truth. The presentation will also discuss future directions for land warfare functionality in production versions of JWARS.

The Advanced Regional Exploratory System (ARES)

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ARES is a developmental campaign simulation model which is object oriented, event sequenced and capable of representing, in a joint and coalition forces context, regional conflicts ranging in scope from a full scale theater operation to lesser regional contingencies. The context is joint in several significant ways: the model represents the forces, capabilities, facilities and activities of all the services and multiple nationalities; other services are asked to participated in the model development process; and the model exists in a hardware and software environment which enables usage by multiple organizations at distributed locations.

Flexibility of campaign representation is realized through a user-specified maneuver network which allows the adaptable and controlled simulation of unit maneuver capabilities and by a robust set of command and control directives which permits the user to control the phased execution of any operational or tactical plan. Other major features include an extensive air operations representation

(developed in coordination with the USAF) closely integrated with ground operations and explicit treatment of communications, intelligence and information flow process.

The ARES model has evolved as a merger (directed by the Deputy Under Secretary of the Army for Operations Research) of the CAA developed Concurrent Theater level Simulation (CTLS) and the U.S Army INSCOM, Studies and Analysis Activity (SAA) sponsored Theater Exploitation Study System (TESS) model.

Wednesday, 1330-1500

The Tail and the Dog: Logistics and Combat Modeling with a Purpose

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The lion's share of campaign level modeling involves replicating several battlefield operating systems (usually only one done well), applying some war fighting analysis and recommending one cource of action as comparatively better. Independent analyses may occur within other staff sections, though insights gained rarely find their way into the section's efforts. These fragmented results fail to provide CINC's with an appropriate range of analysis.

This paper presents a methodology designed to allow comprehensive analysis through the use of integrated models and shared data with the focus on the CINC's campaign. A traditional campaign level model enhanced slightly to accept extra-model data combines with a logistics model, network models and real time intelligence to produce a framework to examine and opposing force's center of gravity; his logistics support structure. With proportional gains in analytical capability and potential insights, most of the battlefield operating systems are replicated or adequately represented. Applying classic Operations research techniques, analysts offer CINCs significant gains among Measures of Effectiveness considered too hard until now.

Dangers lurk, particularly when addressing issues such as model complexity, data requirements and analyst training requirements. Developers tend toward adding one more ornament to the tree, only to find the tree lopsided and cumbersome, if indeed it is standing at all. This presentation also addresses pitfalls associated with model development at the campaign level.

The Logistics Anchor Desk - Supporting the CINC's Campaign Plan

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This paper will address the technical and functional aspects of an OSD sponsored project that applies Artificial Intelligence (AI) technology to address the military logistics functions that are critical to successful battle commanders. This project, The Joint Logistics Advanced Concept Technology Demonstration (JL-ACTD), operates under novel Department of Defense (DOD) guidelines outside those covered in DODI 5000 Evolutionary Acquisition Strategies. The technology deliverable of this program is called the Logistics Anchor Desk (LAD). The LAD is a prototype logistics operation cell where current logistics information is a readily available and powerful analytical tool and simulation provide the capability to examine CINC war fighting sustainment issues.

Objective and Approach:

The objective of the JL-ACTD is to provide the Operational Users (CINCs, CJTF Commanders and Component Commanders) with the capability to rapidly plan and execute more responsive and efficient logistics support to military operations. Informed technology can provide a significant improvement in mission capability through enhanced logistics situation awareness, predictive models and better communications among logistics decision makers.

The approach is to apply mature DOD and commercial sector technologies to a significant subset of critical logistics problems identified by the Operational users. The ACTD has successfully deployed a network of workstations connecting operational planners and logisticians across military services and command echelons. This network will provide the platform for the rapid integration of data and tools adaptable to meet joint mission requirements in CINC exercises and operational contingencies. Advanced data distribution and visualization techniques will provide a common, relevant logistics picture. Integration of existing logistics analysis models with knowledge-based tools will provide powerful decision support to solve logistics problems. A successful ACTD will provide an operational capability and a better understanding of the effectiveness and efficiency of military logistics.

A unique, central focus of this paper will consist of the experience of using LAD to support the European Theater during Operation Joint Endeavor (The NATO Peacekeeping Mission in Bosnia) on a daily basis between October 1995 and the present time.

Wednesday, 1530-1700

Modeling Attack Aviation Operations Using DIS

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This presentation discusses the development and analysis of Army Aviation attack operations using Distributed Interactive Simulation. The scenario setting focuses on theater missile defense. As enemy missile attacks threaten mission accomplishment, the Joint Task Force Commander tasks Army aviation to conduct attack operations against enemy ballistic missile units. The aviation unit undertakes a high-risk night operation in rugged terrain to find and destroy enemy missile launchers. Joint STARS provides near-real time information for the search.

A team of military, government civilian, and contractor analysts used a DIS configuration at the Aviation Warfighting Analysis Laboratory at Fort Rucker to model the operation. The configuration included Extended Air Defense Simulation Model (EADSIM), Advanced Tactical Combat Model (ATCOM), Joint STARS Exploitation Workstation (JSX), Integrated Target Environment Scenario Tool (ITEST), and the Semi-automated forces data logger. The presentation discusses findings and insights regarding attack operations and future DIS work.

Joint Scenarios for Land, Littoral, and Air Warfare

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Uncertain times and decreasing resources are creating more and more joint efforts among the services. These efforts include analytic tools such as JWARS. The Army's TRADOC Analysis Center (TRAC) is starting now in developing robust joint scenarios to support future efforts. TRAC has performed Army analyses in a joint context for numerous years. Recent efforts include the development of robust joint warfare scenarios as they support deep strike and maneuver warfare. These scenarios will incorporate deep strike, interdiction, close air support, SEAD, theater air defense as provided by naval and ground forces, amphibious operations, maneuver warfare, surveillance, reconnaissance, joint communications, support operations and coalition forces in order to analyze our capabilities in defeating threats. These scenarios incorporate smart munitions, theater missile defense attack operations and a detailed review of deployment capabilities. These scenarios provide a tool for analyzing numerous capabilities in a joint context.

Implementation of Close Combat Tactical Trainer (CCTT) Semi-Automated Forces (SAF) Combat Instruction Sets in Modular Semi-Automated Forces (MODSAF)

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Many tasks and behaviors in ModSAF are not traceable to Army doctrine such as Field Manuals (FM) or Army Training and Evaluation Program (ARTEP) tasks. This is the result of a lack of a disciplined approach to knowledge Acquisition and Knowledge Engineering during the development of conceptual models for the behavioral representations. However, a rigourous and validated methodology was used in the development of CISs for CCTT SAF, and preliminary research has shown that their implementation in MosSAF can result in a marked improvement in the individual behavior. The definition of a CIS is shown below.

CIS - English language translations of the ARTEP collective tasks used to describe the vehicle/unit behaviors of the BLUFOR and OPFOR units which make up the Semi-Automated Forces of CCTT and other CATT simulators.

TRAC has been funded to implement a limited number of primitive level CISs in ModSAF for inclusion in the next ModSAF baseline release. A proof of principle was previously conducted, and the results have shown the ModSAF behaviors can be implemented correctly using the CCTT SAF CISs, resulting in a validation of that behavior. This project will result in a more credible version of ModSAF, as the resulting behaviors will be traceable to established Army doctrine. These key CISs, selected because the serve as the basis for many other behaviors, will be discussed in the paper presentation.

`The implementations involve work at the source code level in both CCTT and in ModSAF. The CCTT source code for the behavior is thoroughly examined and outlined so the same implementation can be coded on ModSAF. The technical approach to implementing the CISs will also be presented, including the V&V approach taken for the resulting code.

Thursday, 0830-1000

Modeling Combat Vehicle Misidentification in Simulations

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In a desire to reduce the occurrence of fratricide, the US Army and international the international military community are in the process of investigating various combat vehicle target identification technologies. The baseline system in this investigation is the human observer using electro-optical sensors. The Army intends to use CASTFOREM combat simulation to compare force-on-force effectiveness of the various alternatives to the baseline and to each other. Current modeling of the target acquisition process is based on the ACQUIRE model utilizing the Johnson criteria. This methodology provide no information on incorrect decisions. If a target was not correctly identified, you do not know if it was misidentified or never identified. To correct this flaw, AMSAA has analyzed recent field and laboratory experiments to develop a Johnson criteria for the point at which and observer makes an ID declaration (correct or incorrect). A linear relationship then relates the probability of being correct to the probability of making an ID call. Furthermore, in the absence of situational awareness, a misidentified target is equally likely to be misidentified as a friend or a hostile vehicle. False alarms are also considered in this methodology. This paper describes and justifies the model structure, coefficients, and parameters while highlighting caveats and limitations to this new methodology.

The Personnel Attrition Rate (PAR) Series of Studies: Focus on the Relations Between the Incident of Psychiatric Casualties and Wounded in Action

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The Personnel Attrition Rate (PAR) series of studies took up many aspects of personnel battle casualties in land combat. These studies will be briefly reviewed to set the context.

The remainder of this presentation will focus on psychiatric casualties and their relation to battle stress as represented by wounded in action. Beebe and DeBakey's famous book on Battle Casualties states that "The most uniform and strongest of these relationships [between battle and nonbattle casualties] is the correlation between wounding and psychiatric breakdown in combat troops." This presentation explores some data from army forces in World War I, World War II, and Korea. The aim is to determine whether these data exhibit a consistent relationship of psychiatric casualties to wounded in action for land combat forces.

Can the U.S. Prepare for the Next Peer Competitor?

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Forces Directorate
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A peer by common definition implies an equal or equivalent entity. By this definition it is unlikely that any foreign power or entity can attain the technological prowess, military budget, training experience or power projection capabilities of the U.S. over the next two decades. Yet this paper will argue that U.S. political and military leaders might well miss the indicators of an emerging regional competitor, and thereby find themselves surprised and defeated by a major regional foreign power. The victorious power will be quickly and widely recognized not only as a superior regional power, but also as a strategic peer competitor with the ability to severely diminish the global prestige, alliances and influences of the U.S.

The greatest strategic challenge for the U.S. in the last 80 years has been to prevent the domination by a any power in EURASIA, as this could constitute a threat to US vital interests. Economic and demographic trends, history, political motivation, and local opportunity suggest that China will emerge as peer rival of the U.S. in Asia, probably by 2010. Should China choose to wage asymmetrical warfare exploiting U.S. vulnerabilities and take advantage of local geographic, demographic, and military circumstances, it could the world that the U.S. has met its match.

Through the medium of a scenario, this paper will show how the U.S. may find itself confronted by a peer competitor which should have been obvious, but tragically catches us by surprise.

Thursday, 1300-1530

Some Considerations On The Application Of Soft Factors In Models and Simulations

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In complex and uncertain times we can no longer continue to analyze possible courses of action in models and simulations without considering how human factors affect the course of battle. The intelligence community has been fairly successful at providing information to users on the composition of unit strengths, and performance characteristics of ground forces equipment. Other soft factors quantifying how well a country s armed forces will perform on the battlefield has always been placed in the too-hard-to-do category.

The National Ground Intelligence Center (NGIC) has developed a methodology that evaluates factors such as morale and cohesion, readiness, leadership, training and other factors to assist in quantifying how well countries may be able to fight. In addition to the factors developed by the NGIC, other factors should as sleep loss and the effects of weather on humans can affect the ability to make rational, timely decisions on the battlefield.

The major problem with integrating soft factors into models and simulations is that the data bases required to draw on to develop weighting factors or other methods of portraying the effect of soft factors on the battlefield simply do not exist. Intensive dialog between the intelligence and modeling communities is required to meld conventional modeling techniques with new appraisals of enemy forces. This presentation discusses approaches being explored to improve models and simulations by including information about human factors.

Objective Force Planning

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Current force requirements are generated from single point scenario estimates. The determination of force requirements in the face of an uncertain, multi-polar world needs to be relooked in order to account for the wide range of plausible missions U.S. forces may be called upon to execute. The Objective Force Planning (OFP) process, developed to support the Army's deliberations during the Quadrennial Defense Review, seeks to derive Army requirements from a large scenario space. Adapted from a strategy to task framework, OFP identifies plausible Army missions in the 2010 timeframe, and estimates the primary mission forces needed for these missions. It provides an audit trail from the National Military Strategy (NMS) to supporting missions, strategic objectives, tasks, and the forces needed to accomplish these tasks. A key component of the methodology is the use of the Universal Joint Task List (UJTL) which delineates the joint tasks to apply to any mission. The resultant menu of missions and forces is further reduced through Cluster Analysis to generic, composite groupings of missions and associated forces. These composites enable the derivation of Army capabilities necessary to support a given strategy.

OFP is designed to be implemented in a series of workshops. The workshop structure includes a team of controllers, five (5) teams representing each warfighting CINC's area of responsibility (AOR), and an automation team to facilitate data collection. While OFP is primarily focused on Army requirements, the process methodology has great potential for implementation at the joint level.

Power Projection in the 21st Century: Forces and Concepts

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This presentation describes a project which assisted the Early Entry, Lethality and Survivability (EELS) Battle Lab in assessing concepts and forces for projecting power in various situations that the Army may face in the future. These concepts emphasize the new capabilities and forces envisioned by EELS studies, which have initially focused on the organization, effectiveness, supportability, and deployability of the 2K, 10K and Middleweight early entry forces. The 10K Base force is an existing division(-) with 1999 projected equipment. The 10K Org force is a reorganized 10K Base force with added MLRS and attack helicopters. The 10K Rec force was recommended in the TRAC "Middleweight" study. It is the 10K Base force with technologically enhanced close battle capability.

The project helped the EELS Battle Lab evaluate the effectiveness of such forces. It also examined ways in which the effectiveness of those forces depends on such scenario factors as objectives, terrain, timing, enemy capabilities, and constraints on force employment. This evaluation was conducted at the operational and theater levels, deploying the early entry forces to nearly simultaneous MRCs both in Southwest and Northeast Asia.

Thursday, 1330-1500
Combat MOE's in Relationship to Historical Evidence

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The Ardennes Campaign Simulation Data Base (ACSDB), derived from historical archives, records daily combat status for units engaged in the 1944-45 Ardennes Campaign of WW II. The ACSDB is used to investigate empirical relationships, in the Ardennes campaign, between fractional exchange ratio (FER), force ratio, and FEBA movement. Historical data are used to compute historical FER, and force ratio, for the Ardennes theater battle, and for the Ardennes Bulge battle, in eight 4-day time periods, based on five different system mixes, and two different loss criteria. Correlative empirical relationships, using trendlines, are then sought between FER and force ratio, and between FER and FEBA movement. Results include:

(1) FER vs. Force Ratio. System FER and its associated force ratio are strongly related by an exponential-form relationship when FER is based on losses in at least (combined) tanks, anti-tank (AT) weapons, and artillery systems. Personnel FER and force ratio also have a strong exponential-form relationship, if FER is based on only combat losses (KIA, WIA, CMIA). These exponential-form relationships may sufficiently characterize actual combat to be useful as a validation criterion for simulated combat in theater models.

(2) FER vs. FEBA Movement. System FER may be an indicator of approximate FEBA progress of engaged theater forces. The strongest empirical relationships compute FER using at least (combined) tanks, AT weapons, with a damage criterion based on only destroyed and abandoned systems. Personnel FER on combat causalities appears to be nearly as useful an indicator of FEBA progress as system FER.

Expeditionary Warfare Threat Environment Projections

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This study will be a Marine Corps-specific, DIA-approved intelligence reference document that provides a baseline threat for use in modeling, simulation, planning, and analytical activities in support of weapons acquisition development. The threats to be addressed include those likely to be found in an expeditionary environment with focus on countries of Marine Corps interest as expressed in the Marine Corps Mid-Range Threat Estimate. Timeline for the initial threat projection will be 1997 through 2010.
The study will address the Marine Corps mission, mission area, or special interest area for which the operational environment is being described. Definitions will be sufficiently detailed so as to enable the extraction of those Marine tasks/capabilities that are most sensitive to threat capabilities.

Consequently, the current and future operational, physical, and technological environment in which the Marine Corps forces, weapons, systems will have to function will be discussed. Developments and trends that can be expected to affect mission capability would be projected out to 2010. Areas covered include enemy doctrine, strategy, and tactics that will affect Marine Corps operational planning and capability. Consideration will be given to the interplay of technology and operational factors on adversary doctrine, strategy, tactics, intentions, weapon systems capabilities. Force structure, force employment, training/readiness, and overall capabilities. Besides regional issues, current and future threat systems, their technical performance, characteristics, and capabilities will be compiled along threat hardware functional lines, providing the global technology "menu" from which assessments of applicable systems/technologies to specific military forces can be made. The system specific threat to the mission capabilities of the Marine Corps will be assessed. Lastly, the study shall focus on threat systems and techn0ologies which would affect the lethality of Marine Corps firepower against threat targets.

Rapid Force Projection Initiative C3 Architecture Study

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Abstract not available at printing.

WG 11 - SPECIAL OPERATIONS / OPERATIONS OTHER THAN WAR - Agenda

Chair: Greg Jannarone, Consultant
Cochairs: LTC Joel Parker, USSOCOM
Bob Holcomb, IDA
COL Brian Maher, USAF Special Operations School
Bob Smith, Raytheon E-Systems
Kathy Hoffman, JWAC
John Furman, Mitre
Steve Jimenez, Raytheon E-Systems
Advisor: Rav Stratton. Lockheed Martin
Room: C&CSS Lounge

Room: Command and Control Systems School Lounge

Tuesday 1030-1200
Analytic Tools Requirements for OOTW
Dean Hartley, Oak Ridge National Laboratory

Tuesday 1330-1500
Patrol Coastal Weapon System Analysis using the Joint Tactical Simulation
Lynda Tonus, USSOCOM

SOMROPE: A Simulation Based Risk Reduction Analysis for Robot Assisted Reconnaissance
MAJ John Blitch, USSOCOM

Wednesday 0830-1000
Contingency Analysis Planning System Database Collection
CPT Doug Edwards, TRAC

The Special Operations Forces (SOF) Mission Effectiveness Model (MEM): A Fuzzy Logic Decision Support System
Anthony Cowden, Sonalysts Inc

Wednesday 1330-1500
Nonlethal Munition Simulations in the Joint Tactical Simulation (JTS)
Major John Kelly, USMC MAGTF Staff Training Program

OOTW Decision Support using KBLPS
Curt Fleming, Carnegie Group, Inc

Wednesday 1530-1700
PANEL: Evaluating the Changing Environment and Viability of Arms Control Agreements
Stephen Jimenez, Raytheon E-Systems

Thursday 0830-1000
A Comprehensive System for Early Warning of International Crises: Forecasting from Nose to Horizon (and beyond)
Michael Haxton, Joint Warfare Analysis Center

Event Data and Early Warnings in the Former Yugoslavia
Steven Kurth, Joint Warfare Analysis Center

Thursday 1330-1500
A Methodology for Determining the Impact of Infrastructure Attacks on DoD Operations
John Furman, Mitre

Modeling and Simulation for the Military in the 21st Century
MAJ Ronald Richard, HQ AFSOC
ALTERNATE: Vectored Infrared Personnel Engagement and Returnfire (VIPER) - Pat Gower, NRL

Tuesday, 1030 - 1200

Dean Hartley
Oak Ridge National Laboratory Oak Ridge, TN 37831-7622

Analytic Tools Requirements for OOTW

Abstract not available at printing.

Tuesday, 1330 - 1500

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Patrol Coastal Weapon System Analysis Using the Joint Tactical Simulation

The Patrol Coastal (PC) study assessed the effectiveness of the PC's self-defense capability and its capability to deter an aggressor. The PC's current configuration was compared to other configurations involving new gun and missile systems as well as an upgraded chaff system. The simulation model used to perform the evaluation was the Joint Tactical Simulation (JTS). JTS is a high resolution, multi-sided, interactive, stochastic computer simulation of conflict. The model allows detailed modeling of brigade size joint task forces down to the individual soldier in rural, urban, or water environments.

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SOMROPE: A Simulation Based Risk Reduction Analysis for Robot Assisted Reconnaissance

Special Operations Forces (SOF) are often called upon to execute a variety of high risk missions in denied areas. Not only are such missions inherently dangerous to human operators, but they commonly involve a complex and difficult operating environment with heavy odds against overall mission success. The challenge is further complicated by the unpredictable nature of human activity which may pose a threat to mission success in the form of hostile acts or indigenous endeavors. Virtually all risk reduction efforts (with respect to operator welfare and likelihood of mission compromise) incur significant cost with inherent task limitations in pursuit of overall mission objectives.

Recent advances in the field of Artificial Intelligence / Robotics show considerable potential for operational risk reduction through employment of small robotic reconnaissance systems. This approach can provide a standoff sensing/manipulation capability without necessarily degrading overall mission performance objectives. There are some indicators in fact, that this method might actually expand overall mission accomplishment capabilities while concurrently reducing risk of compromise, overall mission failure, and operator casualties.

The SOMROPE (Special Operations Micro Rover Prototype Evaluation) project strives to analyze this risk reduction potential in order to determine: 1) whether or not continued micro rover development is warranted in terms of today's technology, and 2) what design criteria are most important to robot assisted SOF in a variety of mission profiles

The paper introduces SOMROPE with a brief summary of micro rover design criteria, employment advantages and simulation modeling techniques. Simulation results are then presented in conjunction with a description of the Joint Tactical Simulation (JTS) model which was used as the project's primary evaluation tool. Results are presented in terms of observed risk reduction data and future design criteria. The paper concludes with a summary of micro rover employment issues and recommendations for further development.

Wednesday, 0830 - 1000

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Contingency Analysis Planning System Database Collection

This session will explain the Contingency Analysis Planning System (CAPS) database collection process. CAPS is a software application developed by TRAC for the J-8 to assist in planning for Support and Stability Operations (SASO) by providing the correct numbers and types of troops for any given SASO contingency. It is a joint, unclassified "task-driven" program. The CAPS database consists of an Excel spreadsheet with almost 30,000 cells of information. It contains general unit characteristics and capabilities in relation to 216 critical tasks from the Universal Joint Task List (UJTL). This session will discuss the method of collection, sources used, and circumstances impacting on the process of the CAPS database collection effort.

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The Special Operations Forces (SOF) Mission Effectiveness Model (MEM): A Fuzzy Logic Decision Support System

Navy commandos (SEALs) operate in tactically and environmentally harsh conditions. Some of the factors involved in employing SEAL teams include the capability and nature of the target, the nature of the mission, team size requirements, launch platform, transit platform, and weather conditions such as water temperature, air temperature, sea state, ocean current, darkness, etc. These factors must all he considered in developing new systems to support SEAL team operations, as well as in making key tactical and even strategic decisions concerning SEAL team employment. While it is possible to define the effect of individual decisions on team effectiveness, it is more difficult to determine the overall effect of multiple competing factors. This presentation describes an effort to develop a decision support system (DSS) that utilizes fuzzy logic in assessing the overall effect of multiple competing factors on SEAL team effectiveness. This system was developed to support analysis of theoretical special operations forces (SOF) employment, but could be employed in support of real-world tactical decision-making.

The three developers of this system were Mr. Anthony Cowden, fuzzy knowledge engineer; CDR Walter Merrick, USN (Ret.), a former SEAL and the subject matter expert (SME) for the project; and Dr. R. Scott McIntire, mathematician and software engineer.

Wednesday, 1330 - 1500

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Nonlethal Munition Simulations in the Joint Tactical Simulation (JTS)

As the Executive Agent for the Joint Nonlethal Weapons Program, the Marine Corps is examining the use of nonlethal munitions in order to increase commander's flexibility in conflicts where rules of engagement will be more complex The Commandant's Warfighting Lab (CWL) was assigned the task of investigating the tactics techniques and procedures related to nonlethal weapons. and was directed to use simulation in the course of its research.

JTS was modified by Lawrence Livermore National Laboratories to simulate the effects of nonlethal weapons. Performance data on the subject munitions was collected by CWL and this data was imported into the appropriate JTS data fields. A scenario that modeled a MOUT operation from the 101 st Airborne Division's Exercise MEGA GOLD was created and numerous interactive simulation exercises were conducted. The simulation exercises ran the scenario several times with lethal munitions only and then several times with a combination of lethal and nonlethal munitions

The post processing utilities of JTS were used to collect data that was analyzed by CWL. CWL then examined various data items to draw insights into the tactical use of nonlethal munitions in a MOUT environment

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OOTW Decision Support Using KBLPS

Abstract not available at printing.

Wednesday, 1530 - 1700

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PANEL: Evaluating the Changing Environment and Viability of Arms Control Agreements

The end of the post-Cold War has witnessed the successful negotiation, and entry into force of numerous arms control agreements. Many of these agreements have been bi-lateral and multi-lateral agreements between the United States, NATO, former Warsaw Pact states, and the former Soviet Union and it's successor Commonwealth of Independent States. The analytical aspect of assessing arms control viability has for the most part not occurred.

The purpose of this two year, ongoing research project, based on an earlier portion that was presented at an international conference in the Fall of 1996 in Makuhari, Japan, and quoted in the Japan Times was to assess several key areas effecting arms control viability. First, has the international environment's change from a bi-polar Cold War environment to that of a multi-polar post-Cold War environment changed the nature of arms control and proliferation, and if so how? Second, what is the correct unit(s) of analysis for assessing the viability of arms control agreements? Do non-state actors and proliferators effect the viability of arms control agreements. Third, based upon evaluation of the first two areas, what are viable non-standard measures of effectiveness for the viability of arms control

agreements. The assessment of arms control MOE's requires the development of a static decision spreadsheet based model. This model is presently under development.
This abstract is unclassified and approved for public release; distribution unlimited.

<u>*Thursday, 0830 – 1000*</u>

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A Comprehensive System for Early Warning of International Crises: Forecasting from nose to horizon (and beyond)

Automated systems of early warning of international events based on quantitative information provide several advantages, including allowing more efficient use of intelligence and expert analysts, providing considerably greater lead time than human analysis alone, and allowing the systematic improvement of the forecasts. In this paper, I outline one potential system for complete and robust forecasting that brings together disparate strains of academic research. I propose means of adapting these approaches to improve their capabilities, both methodologically and operationally. The approaches combine parts of expected utility theory, time series analysis of events, structural conditions of conflict and systems theory. In adapting these approaches, I suggest several analytical techniques for utilizing these diverse approaches in a comprehensive and synergistic system.

This paper concludes by discussing the potential operationalization of this system for both strategic and tactical efforts. Due to the quantitative nature of the models, they must be coupled with human-based expert risk assessment in order to accurately assess the validity of the warnings, placing these warnings into the appropriate context. The focus of any such system would be to minimize surprise and maximize military readiness in a increasingly uncertain international threat environment.

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Event Data and Early Warnings in the Former Yugoslavia -- Abstract not available at printing.

<u>*Thursday, 1330 - 1500*</u>

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A Methodology for Determining the Impact of Infrastructure. Attacks on DoD Operations -- Abstract not available at printing.

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Modeling and Simulation for the Military in the 21st Century

With the Cold War behind us and the uncertainty of the 21st century just around the corner, there are many issues that must be examined in the halls of the Pentagon. Without the threat of a peer competitor in the near future, it's unlikely that the military of the next century will resemble what has been developed over the last 50 years. How we reshape our forces, what we develop and procure, and how we maintain readiness will be the three main challenges of the future. To effectively address these challenges we must develop and use advanced modeling and simulation systems even more than we have in the past. In the future we must be able to forecast across multiple operating environments to determine our optimum force structure. The cost of research, development, acquisition and testing of weapons systems has increased exponentially in the last 50 years. The required flexibility of our future force will drive the need for advanced simulation systems to maintain readiness. The weeks and months of training time now required to get our forces ready for deployment must be done in a matter of days and hours in the future. We will have the storage and computational power required to develop these systems, but we need the community to focus on the needs of the users and the development of the software and systems integration.

WG 12 - ANALYTIC SUPPORT TO TRAINING - Agenda
Chair: Mr. Brian R. McEnany, Science Applications International Corporation
CoChair: LTC Henry Coble, Joint Staff/J7 (Joint Training Branch)
Advisor: Mr. Michael Parmentier, Director (Readiness and Training) ODUSD(R)
Room: C&SC – CR-103 and CR-109

Room: C&SC – CR-103

Tuesday, 1030-1200
Introduction to New Working Group
Chair/CoChair

A Joint Training Vision for the Year 2010
LTC Henry Coble, USMC, The Joint Staff, J7 (Joint Training Branch)

The Joint Simulation System (JSIMS)
Dr. David R. Pratt, JSIMS Joint Program Office, CAPT Drew W. Beasley, USN, JSIMS Joint Program Office

Tuesday, 1330-1500
JSIMS Maritime Approach to Training
CAPT Lee Dick, SPAWAR

An Event Based Approach for Training: Enhancing the Utility of Joint Service Simulations
Randy Oser, J. Cannon-Bowers, D, Dwyer, Training System Div, NAWC, H. Miller, Advanced Telecommunication Inc

Assessing Training Performance during Joint Training Exercises
Dr. Frank Moses, US Army ARI, LTC James Love (Ret)

Wednesday, 0830-1000
Joint Training System Automation: Achieving Requirements Based Training
Michael Wagner, DRC, Dr. Dave Promisel, HRED, MANPRINT

Unit Training Mix Model
Phillip Djang, US Army TRAC-White Sands, Paul Finch, New Mexico State Universitiy

Determinants of Battlefield Training Strategies
Dr. Frank Moses, Dr Angelo Mirabella, US Army ARI, Edward Matto, The Consortium Research Fellows Program, ARI

Wednesday, 1330-1500
COMPOSITE GROUP VI SESSION .... Ellis Hall

Room: C&SC – CR-109

Wednesday, 1530-1700
Real Time Analysis for Joint Warfighters
LTC Thomas K. Littlefield, USACOM-JTASC

ASW Measures of Proficiency
CAPT Bruce Linder, Fleet ASW Training Center, Michael McDevitt, Kapos Associates

Time and Command Operations: Focusing on Joint Modeling and Simulation Needs for Training and Operation at the Unified Commands
Dr. R. Worley, IDA, Michael Vernon, AB Technologies, Inc

Thursday, 0830-1000
USAF Prime Warrior Wargaming Course
LTC Robert Donohue, MAJ Michael Loftus, USAF Wargaming Institute
Michael Garrambone, Veda, Inc.

Battle Synchronization Criteria
Douglas MacPherson, US Army ARI

Virtual Adaptive Training Environment for OOTW
LTC Annette Sobel, Sharon Stansfield, Sandia National Laboratories

Thursday, 1330-1500
IPB Process Value Added
Dr. Niki Deliman, E. Alex Baylot, Jeffery Williamson, US Army Waterways Experiment Station, Laura Bunch, MEVATEC Corporation

Army National Guard Reduces Simulator Costs with Optimization Model
Phillip Djang, US Army TRAC-White Sands

Analysis of Loss of Proficiency of TRADOC School Graduates Due to Decreasing Resources
Katherine Stapp, Dr. Edward George, US Army TRAC-White Sands

WG 12 - ANALYTIC SUPPORT TO TRAINING - Abstracts

Tuesday, 0830-1000
A Joint Training Vision for the Year 2010

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Chapter One of Joint Training, focused on the creation and installation of a system for Joint Training, is about to close. As the nation embarks upon the 21st century, in the next chapter---chapter two---the Joint Training System is intended to be the stabilizing force in a national security environment characterized by uncertainty. In the next century joint training will need to provide well-trained military forces able to dominate in a wider range of threats than that experienced in the past, threats emerging unpredictably anywhere in the world, employing varying combinations of technology. Also, joint training must accommodate a revolution in military affairs where information superiority is the "high ground" and force structure has been modified to swiftly leverage information through flexible, smaller, more lethal forces. Joint training in the year 2010 will rely heavily upon distant learning, telecommuting to centers of learning excellence where America's technology will be brought to bear in modeling the "mission space" for cheaper, more effective development of warfighting skills. This presentation will outline the Joint Training Vision for 2010 and how the Joint Training System will develop to accommodate the changes thrust upon national security.

The Joint Simulation System (JSIMS) - An Overview

Dr. David R. Pratt
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The Joint Simulation System (JSIMS) is the flagship program of the next generation of constructive models. JSIMS is a single, seamlessly integrated simulation environment. It includes a core infrastructure and mission space objects, both maintained in a common repository. These can be composed to create a simulation capability to support joint or service training, rehearsal, or education objectives. In this paper, we will present the program background, overarching requirements, development methodology, and program implications.

The goals of JSIMS are intrinsically ambitious. After the first phase of development, or Initial Operational Capability (IOC) in 1999, JSIMS must replace the functionality of the Joint Training Confederation (JTC), increase the fidelity of joint service training, significantly reduce exercise support resources, and interact with the user via their real-world Command, Control, Communication, Computers, and Intelligence (C^4I) systems. The next phase of development, which will lead to Full Operational Capability (FOC) in 2003, will expand the capabilities of the IOC system. It will include the ability to resolve down to the platform level, support development of new doctrine and tactics, provide a mission rehearsal capability, facilitate linkages with other models, and support for a wide range of military operations.

Historically, models designed for training have also been used for analyses. Thus, a dialogue between the analytic community and the JSIMS Joint Program Office (JPO) is highly encouraged. An understanding of the JSIMS program structure and goals by the operations research community is apt to provide better tool selection for future analytic needs.

Tuesday, 1330-1500
JSIMS Maritime Approach to Training

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This presentation will discuss the development of Maritime products for the Joint Simulation System (JSIMS) and how JSIMS will be applied to meet Navy training needs as it replaces the RESA model in the Joint Training Confederation and ENWGS as a Shore Tactical Training and Wargaming tool.

The presentation will include a brief on the description of the objectives and overarching requirements and the distributed development process including domain analysis, domain design , software engineering and fleet integration and testing. Discussion will also include the use of learning methodolgy, integrating to C4I and Tier I operator training systems, and how pre- and post- processing functions could be linked to mission planning and assessment tools.

An Event-Based Approach For Training: Enhancing The Utility Of Joint-Service Simulations

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Abstract not available at printing.

Assessing Training Performance during Joint Training Exercises

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This work-in-progress will transition multi-Service and Joint force performance assessment and feedback tools to military trainers and decision-makers. Tools include techniques and metrics for assessing how well higher-echelon forces communicate, coordinate, and synchronize resources and firepower to achieve mission essential tasks. The ultimate purpose of these tools is to develop procedures by FY01 for making performance-based estimates of training proficiency and training readiness. The current presentation is about the FY97 initial project phase to provide performance assessment and feedback tools for the joint targeting process in the Joint Air Operations Center. The focus is on the planning activities in joint targeting involving judgmental decision-making skills and military "art." The paper discusses the process of developing understandable and meaningful measures of effectiveness and of performance. It

includes approaches to developing: (1) joint training objectives – not to be confused with missions, operations, processes, and tasks; (2) self-assessment criteria and procedures for systematically determining what is done compared to standards/commander's intent; and (3) feedback and after-action review formats for cell/team leaders and commanders about what was done well and what might benefit from changes. The work is documented with data and actual experience derived from exercises at the Battlestaff Training School (Blue Flag) specializing in Joint Force Air Component Commander (JFACC) team training. The project titled "The Joint and Multi-Service Distributed Training Testbed" (JMDT2) is part of "Joint Training Readiness," a Defense Technology Objective (DTO) and an Army Science and Technology Objective (STO).

Wednesday, 0830-1000

Joint Training System Automation: Achieving Requirements-Based Training

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The Joint Staff (J-7) and the Joint Warfighting Center are implementing a process by which joint force commanders analyze their missions and establish mission requirements. These requirements are described using a common language of tasks, conditions, and standards based on CJCSM 3500.04A, the Universal Joint Task List (UJTL), and following the Joint Staff's JMETL Development Handbook guidance. These requirements provide a basis for planning, conducting, and evaluating joint training in accord with processes described in CJCSM 3500.03, the Joint Training Manual.

There are several keys to requirements-based training. First of all, the warfighting requirements must be fully captured. These warfighting requirements may encompass a wide variety of missions (a key during uncertain times). This is accomplished in the Mission Requirements Module (MRM) software employing the task, conditions, and measures of performance structure of the UJTL and operations templates, which are designed to graphically depict all of the tasks involved in each command mission and their interactions.

Secondly, in the planning of joint training, it is important to identify training activities reflective of the mission requirements and training audiences consistent with forces assigned in OPLANs. The training activities selected should be consistent with respect to both tasks and conditions.

Third, in the execution and assessment of these joint training activities, objective data must be collected within the same mission-focused task, conditions, measures of performance framework to permit commanders to analyze their training status on various tasks and to roll up these results to determine their near-term capability to execute assigned missions.

The automation of the joint training system, integrating the requirements, planning, execution, and aassessment phases via the UJTL framework, allows levels and types of analysis that heretofor was totally impractical.

Unit Training Mix Model

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The simulator/simulation study, which is being conducted by the U.S. Army Training and Doctrine Analysis Center - White Sands, analyzes the problems of maintaining a highly trained force in a period of significant turbulence. A major goal of this study is to develop an analytic system that can examine the relationships between training aids, devices, simulators and simulations (TADSS) and their associated costs. In order to accomplish this goal, we developed a optimization program to select a mix of TADSS that trains all military tasks at the lowest possible cost.

We have incorporated the model and cost and effectiveness database into a decision support system that will allow the construction of mission specific training strategies. We provide initial results and demonstrate how our decision support system can construct new training strategies to meet new missions.

Determinants of Battlefield Training Strategies

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Abstract not available at printing.

Wednesday, 1330-1500
COMPOSITE GROUP VI Session

Wednesday, 1530-1700
Real Time Analysis for the Joint Warfighter

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The roots of operations analysis work go back to World War II where analytic results contributed to military successes such as the Air Battle of Britain, the Island Campaign in the Pacific, and the Battle of the North Atlantic. Today we continue this legacy by providing analytic support to joint planners, primarily during their deliberate planning cycles. There is also a need to provide analytic support during crisis action planning. In fact, as soon as a deliberate plan is pulled off the shelf for execution, the crisis action planning process begins. Planners have to produce a viable plan in an intense and time critical environment.

The purpose of this presentation is to demonstrate an approach for providing real time analysis to the joint warfighter. We found that the process is more important that the analytic tool. This process is based upon tearing down the wall that exist between the operator and the analyst. This is done by building credibility with the operator, understanding his requirements, and providing analytic results that fit into his battle rhythm. Typically, results must be turned around within a three to six hour period. Anything slower is often a wasted effort, decision will be made with or without analytic results. This presentation doesn't provide all the answers; however, it provides the insights and approaches that have evolved in the Analysis Branch at the US Atlantic Command during support provided to the Unified Endeavor exercises and an actual contingency.

ASW Measures of Proficiency

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The presentation describes the rationale, procedures and methodology used to develop improved Anti-Submarine Warfare (ASW) Measures of Proficiency for the four ASW communities (air, surface, submarine, and IUSS) in the Navy. An innovative three-dimensional conceptual "Process Model of ASW" is described and illustrated with an interactive linking of thirteen phases. Measures of

activity for team *processes* and Measures of Proficiency for outcomes are compared. Measures of input for *resources* related to proficiency are discussed. Three hypotheses are proposed that relate *processes, resources* and *outcome*s with proficiency.

A conceptual "Proficiency model" and a revised approach for determining supporting resources is discussed. resources which underpin proficiency are subdivided into five areas" people, experience, knowledge, aptitude, and materiel (PEKAM). Additionally, factors such as team stability, currency of experience, team leadership and equipment/weapon capability are discussed as they impact on performance.

Experimental Design and Data Collection are discussed. Effects of modeling and simulation (M&S) in training and advanced computer and database applications are highlighted. An EXCEL based spreadsheet with Visual Basic programming for data management and ACCESS based data collection instruments are demonstrated. These software applications can be converted for use in Personal Digital Assistants (PDA) or embedded in training system.

Preliminary results of the study and recommendations are discussed, proposed revision to the SORTS readiness reporting system i(in use by Navy forces worldwide) and a recommendation for further study in the area of aptitude measurement.

Time and Command Operations (TACO):
Modeling and Simulation for Training Joint Operations

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The effects of the last decade's dramatic changes in threat and budget have yet to reach a steady state. Perhaps the most significant change is the shift in emphasis *away* from a standing, detailed plan to be implemented by a permanent organization against a known and powerful threat and *toward* creating a temporary organization and creating a plan in response to a rapidly emerging crisis. Other trends include a persistent increased emphasis on Joint operations and on unconventional forms of warfare.

The Joint Task Force (JTF), a temporary command, has emerged as the CINC's instrument of choice. The Joint commands—the unified commands and JTFs—are responsible for decision making in the strategic and operational time frames. Yet, the most prominent training event is conducted in the tactical time frame. Higher echelon decision making is manifest in a *plan*. However, the dominant training event is oriented on real-time *plan execution* rather than on *plan development*. The support requirements for creating a Joint force and for producing a plan quickly are different than those for supporting a standing command with a standing plan.

To meet the needs of the Joint commands, M&S should be structured around broad functional areas—crisis response, deployment, strategic and operational employment, crisis termination, and redeployment—rather than focused on tactical engagements. Finally, the increasing requirement to operate in undeveloped areas demands that JTFs plan, implement, and manage logistics, communications, and intelligence infrastructure rather than rely on in-place infrastructure. Training and M&S requirements follow.

Thursday, 0830-1000
USAF Prime Warrior Wargaming Course

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The Prime Warrior Program is a CSAF directed response to prepare Air Force participants for joint wargames, analyses, and exercises. To validate and document this formal training, a Training Systems Requirements Analysis (TSRA) was initiated by AF/XOC, the Air Force Air Education and Training Command, and Air Combat Command. The analysis was conducted by the USAF Wargaming Institute, Maxwell AFB, AL with support from Veda Inc. to determine the knowledge requirements and subject area focus of the wargaming course. This unique presentation summarizes the results of a large scale survey on wargaming exercises and provides a complete description of the course program of instruction. The briefing concentrates on the contents of four educational blocks; two supporting blocks on fundamentals of Operations Research and concepts of Modeling and Simulation, a block devoted to Doctrine and Operations, and the primary block on Wargaming and wargaming models. Presentation attendees will find the briefing to be both enlightening and entertaining since the subject of wargaming carries both a military warfare and purely intellectual stimulating perspective. In addition, this presentation will demonstrate several multimedia educational products which will be used to support instruction.

Battle Synchronization Assessment Criteria

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The Army's success on the battlefield depends on its ability to synchronize its Battlefield Operating Systems (BOSs) so that their effects summate and produce maximum relative combat power at decisive points. Recent ARI research demonstrated that it is possible to define specific types of synchronization objectively, identify types of synchronization in plans, and count occurrences of them in battles from Janus' simulation databases. This presentation describes the development of assessment criteria for the process and products of synchronization and reports how they apply to a defensive battle. The assessment criteria were developed from Army doctrine and from published weapons' effects. Synchronization was defined as the relationship among specific pairs and triplets of BOSs. For each of these, objective criteria were identified as indicators of when synchronization does and does not occur. Some of these criteria include: (1) number of obstructions completed at the planned time, (2) obstructions fired on by direct fire or by artillery; and (3) suppression of OPFOR during his attack. The assessment criteria were applied successfully to data obtained from the Tactical Commanders Development Course, Ft. Leavenworth using the Janus battle simulation environment. This application of the criteria suggested ways in which synchronization could have been improved. The criteria potentially have broad applicability because they are: (1) compatible with synchronization doctrine, (2) comprehensible and believable, (3) diagnostic of synchronization training, (4) planning and execution problems, and (5) computable and available for use in after action reviews. Discussions of the assessment criteria and their application will be encouraged as part of this presentation.

Virtual Adaptive Training Environments For Operations Other Than War

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Fully immersive, reconfigurable virtual environments for small team training have great potential as training tools. As greater demands are placed upon our military forces for multiplication of effort, capability, and seamless transition, effective training environments require increased realism and transparency to the user. Virtual environments empower the user with greater control over the scenario generation and objectives. This effort emphasizes the extension of fully immersive, multisensory training platforms for small team situational training. OOTW scenarios have undergone proof-of-concept and user validation. Initial human factors assessments have been performed which indicate high user confidence, acceptance, and interoperability with current training systems. Several applications will be discussed to include: field medical training/humanitarian service; and counterterrorist response training for small teams.

Thursday, 1330-1500
IPB Process Value Added via Computer Aided Procedures: Methodology and Results

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Intelligence Preparation of the Battlefield (IPB) functions at echelons brigade and below are typically time sensitive, time consuming procedures performed manually. Computer aided procedures (e.g., ground vehicle mobility assessments) complementing or replicating traditional manual approaches exist but are not readily available at brigade and below. Increased quality, consistency, objectivity, and completeness in product and analyses as well as time saving for the analyst potentially results form utilizing such computer-aided products.

Under sponsorship of the Office of the Deputy Chief of Staff for Intelligence, Headquarters, Depart of the Army, the US Army Engineer Waterways Experiment Station with over 40 years of experience in vehicle mobility research, conducts a study as par tot the FY96 Army Study Program to identify mobility IPB functions and assess value added in automating them at echelons brigade and below. The study incorporated formal hypotheses, analytic rigor and soldier involvement. Designed experiments with the Military Intelligence Officer Advanced Course and questionnaire disseminated to Army S2 staff and course participants were employed to assess value added. The study provides a prospective framework for evaluating the impact of decision support technologies and battlefield digitization on performance. The purpose of this paper is to present study methodology and findings.

Army National Guard Reduces Simulator Operating Costs with Optimization Model

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US Army Training and Doctrine Analysis Center-White Sands
White Sands Missile Range, NM,

Between now and the year 2000, the U.S. Army will field 21 high-fidelity mobile networked tank and infantry fighting vehicle training simulators called the Mobile Close Combat Tactical Trainer (M-CCTT) to the Army national Guard and Reserve Component. Each Mobile CCTT consists of a number of simulator vans (networked computers), a maintenance van, and a generator trailer; for a total of 6 (armor) to 7 (infantry) tractor trailer vans. These simulators must provide training to geographically dispersed units. We were asked to determine where to home-base the simulators. Combinatorial models that determine where to home-ase each simulator and then, how to route each simulator so that all units can participate in simulator training. Our solution reduces the operational cost by \$8.6 million/year. Additional (unaccounted) savings accrue from reduced wear and tear on equipment and facility upgrades.

We transposed our location and routing solution onto U.S. maps so that they became an easy-to-grasp visual decision tool. Our solutions were reviewed and approved by the Army national Guard Bureau and the System Manager-Combined Arms Tactical Training. The solution is the basis for the fielding plan and contract renegotiations.

Analysis of Loss in Proficiency of TRADOC School Graduates Due to Decreasing Resources

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The U.S. Army Training and Doctrine Command (TRADOC) initiated a study to determine the impact of reductions in training resources on the capabilities of their graduates in October of 1994.

The impact of shrinking training budgets have been widely felt throughout the Army but not quantified in any real sense for several years. DOD expressed a need for an analytic measure that would address quality of training issues and provide quantitative evidence in support of the value of training and leader development. The Army requires a way to convincingly demonstrate to civilian leadership the important linkages between resources, training, and combat effectiveness.

The tool selected by TRAC-WSMR, the study agency, to model the impacts of budget decisions on the proficiency of school graduates is System Dynamics. System Dynamics is a framework and methodology for becoming more aware of the full consequences of the actions that are taken or are being considered to effect change within organizations and the world at large. As interdependencies expand, the likelihood of any action having unintended consequences increases. The role of modeling takes on a new significance as a tool to manage and facilitate change and to create new training paradigms for the Army of the 21st Century.

WG 13 - ELECTRONIC WARFARE & COUNTERMEASURES - Agenda

Chair: Mr. Michael F. Gauble, Lockheed Martin Corp.
Co-Chair: Mr. Nicholas J. Basciano, ARINC Inc.
Co-Chair: Mr. Thomas H. Plank, Sverdrup Technology, Inc.
Room: C&SC – CR-107

Room: C&SC – CR-107

Tuesday, 1030-1200
Electronic Combat Data Exchange
Messrs. John Crane and Thomas H. Plank, Sverdrup Technologies, Inc.

A Joint Electronic Attack Mission Data Optimization Effort
Mr. Jerry D. Sowell, - USAF - 53d Wing/68ECG/36BETS/EEA

Tuesday, 1330-1500
Electronic Warfare and Countermeasures in JWARS
Lt. Col. John O. Yanaros, Jr., USAF - JWARS Office, Office of Sec. Of Def.

Reactive Jamming Requirement and Benefits
Mr. Fred Roffe, Northrup Grumman Corp.

Wednesday, 0830-1000
Electronic Warfare Visualization and Simulation
Messrs. Nicholas J. Basciano, Richard B. Mead, Daniel D. Reuster, ARINC

A New Approach to Quantifying the Payoff from ECM Robustness Analyses
Maj. (Dr.) Suzanne M. Beers, USAF - AFOTEC/CNP, Dr. Sam Baty, BDM International

Wednesday, 1330-1500
(The following two papers treat different aspects (modeling/analysis) of a common project at AFIWC)

Evaluating the Robustness of ECM Techniques
Lt. A. David Cummings, USAF - Air Force Information Warfare Center/SAC

Threat System Configuration Changes on AM Modulation Effectiveness
Lt. Todd C. Burwell, Mr. Rudulphe Peltier, USAF - Air Force Information Warfare Center

Wednesday, 1530-1700
The Partnership Process for Electronic Warfare Acquisition
Maj. Arthur F. Huber II, Lt. Col. Jay G. Santee, USAF

Thursday, 0830-1000
Modeling and Simulation in Navigation System Test and Evaluation
Maj. Eileen A. Bjorkman, USAF - 746th Test Squadron

Emitter Location and Display Simulation (ELADS)
Mr. John DiModica, Northrup Grumman Corp.

WG13 - ELECTRONIC WARFARE & COUNTERMEASURES - Abstracts

Tuesday, 1030-1200
Electronic Combat Data Exchange
Messrs. John Crane and Thomas H. Plank
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Currently, sharing between the services of engineering and test data used to develop mission data for electronic combat (EC) jamming systems employed against common threats is limited. This results in duplication of effort and wasted time and money. The paper describes the Electronic Combat Data Exchange (ECDATX) system being implemented by the 36th Engineering and Test Squadron at Eglin AFB, FL. The system addresses the sharing of ES data throughout the DOD using existing communications links and the application of emerging Web technologies. The ECDATX home page (http:/143.157.16.1/) is available through the Secret Internet Protocol Router Network (SIPRNET) and provides access to EC data and analysis applications. As other users implement Web servers, ECDATX will evolve into a distributed architecture.

The paper includes an assessment of the ECDATX near-real-time data sharing capability conducted as part of a MOBCAP EAST ground mount evaluation. Test support personnel loaded data as it was collected on the ECDATX server at Eglin. Engineers at remote locations were able to analyze the collected data using associated applications. The engineers were then able to recommend mission data modifications to on-site engineers that same day.

The Jammer Effectiveness & Techniques (JET) Web effort initiated by the Air Force Electronic Warfare Integration Office (AF/EWIO) is expanding the ECDATX data sharing concept to establish a community-wide, information sharing capability including developers, testers, and users. The JET Web architecture envisions linking different levels of critical and related information with an open architecture of data servers using current and emerging Web technologies.

Joint Electronic Attack Mission Data Optimization Effort

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Defines the differences between Electronic Attack (EA) techniques and EA Mission Data (MD) from an operation perspective. Addresses the operational users historical approach to ensuring operational MD robustness and the documented impact on the design of the selected threat systems. Discusses the approach taken by the user to develop robust MD by the application of state-of-the-art technology to determine the "how and why" specific MD is effective.

Reviews the planning, conducting, and results of a joint effort (multiple services and contractors) to develop MD by using a secure wide area net to Near Real Time exchange test planning, data, analysis, and results..

<u>Tuesday, 1330 – 1500</u>

Electronic Warfare and Countermeasures in JWARS

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The Department of Defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

This briefing will address JM&SRG requirements, User Group defined scenarios/partitions/use-cases, and associated MOPs / MOEs that will shape the development of JWARS. Potential legacy models and functionality's for reuse will be presented, derived through JWARS workshops and Web site discussions. The presentation will conclude with a status update on the JWARS program. For Electronic Warfare (EW), with respect to 65th MORSS WG interest, initial JWARS work (IOC) focuses on destruction of C2 and information nodes, electronic protection and electronic attack. IOC development will include EW representation from air, land, sea, and special forces and it's application to joint operations.

Reactive Jamming Requirement and Benefits

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Approved abstract not available at printing

Wednesday, 0830-1000

Electronic Warfare Visualization and Simulation

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Performance analysis of various Electronic Warfare (EW) capabilities (Communications Systems, Radars, and Jamming Systems) has been a significant goal of the EW community for many years. In recent years, analyzing the effects that these EW systems will have on the outcome of particular military operations has emerged as the significant new goal for the EW community. With current advances in battlefield simulation and visualization comes the requirement to incorporate the expertise of the EW community. Currently, EW simulation in wargaming is little more than statistical and does not leverage the results of the EW community's current analysis. As the quality of battlefield simulation and visualization increases so too will the need for higher quality EW simulation. This presentation demonstrates a possible method for including high resolution EW simulation into current battlefield simulation and visualization efforts.

The method is based upon the projection of semi-transparent objects about a military platform of interest (aircraft, SAM site, etc.). The semi-transparent object's physical characteristics represent the power, angular variation, and sensitivity associated with each of the electronic communication, radar, and jamming systems on-board the platform. As the platform interacts with other platforms in the wargaming simulation, so to will the projected objects. For communication systems, communication links are established when the communication objects about two platforms intersect. similarly, a radar detection system on one platform may detect the presence of another platform when the object corresponding to the radar system intersects the object corresponding to the radar cross section of the other object. In essence, the intersection or separation of two associated objects is used to trigger an EW related event which influences the behavior of the effect platform.

A New Approach to Quantifying the Payoff from ECM Robustness Analyses

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Robustness is a key feature in electronic countermeasure (ECM) effectiveness determination. As used here, robustness has two facets. First, an ECM technique is robust only if it is effective over the expected variations in individual missile performances. Parameters such as gate widths, alignments, delay times, resolver scan rates, and electronic counter-measure (ECCM) thresholds can be expected to vary from missile to missile and can, in fact, vary in an individual missile over time. If an ECM technique cannot maintain its degradation capabilities over these variations, then it is indeed fragile and not resilient.

The second important ingredient in the robustness issue is the ability of the ECM Technique to hold up in the presence of minor modifications (which should be anticipated). Experience has shown that threat systems are routinely upgraded to make them less susceptible to ECM. While specific waveforms used on allied aircraft are classified and not disseminated, general ECM techniques—including gate stealing and angle deception—are routinely discussed in open literature. Thus, it can be expected that our adversaries will be searching for ways to counter these known techniques.

The Air Force Operational Test and Evaluation Center (AFOTEC) is taking the lead in addressing the robustness issue. Through AFOTEC sponsorship, the Missile Space and Intelligence Center (MSIC) measured key parameters on several different rounds of the same missile system. The data were used in a modified version of the ESAMS surface-to-air missile simulation to determine the impact of the parameter spreads on some specific ECM techniques. The effort provided insight into other parameters that should be measured and some trends or directions in which the missile system may evolve to become more resilient to ECM.

The purpose of this presentation is to document how the robustness analysis was performed and to quantify the payoff from its accomplishment. First, some background information is provided to show how the ability to conduct has evolved. Next some examples of robustness findings are provided. Finally, the issue of quantifying robustness payoff is addressed.

__Wednesday, 1330-1500__
(The following two papers treat different aspects (modeling & analysis) of a common project at AFIWC)

Evaluating the Robustness of ECM Techniques

Lt. A. David Cummings
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Phone: (210) 977-2391

Traditionally, the operational effectiveness of Electronic Countermeasures (ECM) techniques was determined exclusively in flight tests. Flight tests were good in providing results of high confidence but limited in terms of scope. Due to the small number of available test assets typically employed, testing provided little insight into the impact of variations in the threat performance on measurement of ECM effectiveness. Recently, a new focus has been placed in the Air Force on evaluating the effectiveness of ECM against a broad spectrum of system variations. This initiative is called Robustness Analysis and makes use of modeling and simulation (M&S) in support of traditional testing. Key to the analysis are the detailed digital models of threat systems which reproduce the effects of ECM on the given system. Models are then coupled with information and assessments of threat variations available from intelligence, exploitation, and hands-on experience gained during the modeling process. A capability is thus realized to create in simulation a realistic cross-section of the threat system population. This sample provides the basis for assessment of ECM effectiveness—the essence of Robustness Analysis. We present results of a proof of concept demonstration performed at the Air Force Information Warfare Center (AFIWC). Simulations are generated and statistically analyzed to evaluate the robustness of a given ECM technique.

Threat System Configuration Changes on AM Modulation Effectiveness

Lt. Todd C. Burwell, Mr. Rudulphe Peltier
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102 Hall Blvd., Ste. 342
San Antonio, TX 78243
Phone: (210) 977-2391

Traditionally, the operational effectiveness of Electronic Countermeasures (ECM) techniques was determined exclusively in flight tests. Flight tests were good in providing results of high confidence but limited in terms of scope. Due to the small number of available test assets typically employed, testing provided little insight into the impact of variations in the threat performance on measurement of ECM effectiveness. During a flight test a single component of a test asset had to be replaced. this minor change in the test asset affect the AM Modulation ECM technique. Using the Threat Engagement and Analysis Model (TEAM) the effect of random configuration changes were studied against this ECM technique. This paper will discuss the results of this quick look analysis on threat system configuration changes to AM modulation effectiveness. We will also include a validation of the TEAM model using flight test data.

__Wednesday, 1530-1700__
The Partnership Process for Electronic Warfare Acquisition

Maj. Arthur F. Huber II, Lt. Col. Jay G. Santee, USAF
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Phone (703) 697-0660

The Partnership Process is an acquisition reform initiative that has emerged from the electronic warfare (EW) community. This initiative combines many recent military acquisition reform efforts into a holistic and detailed process for developing and fielding needed weapon systems. The new process also draws on lessons learned from world-class companies to re-engineer EW acquisition. these companies are customer-driven, consequently the Air Force acquisition community must respond to the voice of its customer, the warfighter, by using military worth as the procurement criterion. Top companies maintain open dialogue with their suppliers, so the Partnership Process emphasizes new ways of fostering communication with industry. The best organizations achieve their results through continuous optimization, so we adopt methods to converge on best solutions.

The new acquisition process can be summarized by six activities: *Quantify Mission Deficiencies, Establish Requirements, Convey Requirements, Select the Source, Develop the Solution and Evaluate the Result* that consistently put superior solutions into the hands of our warfighters as quickly and inexpensively as possible.

The results summarized in this paper were achieved over the past year and a half through a series of intensive integrated process team (IPT) meetings that included broad representation from military organizations and US contractors. While the insights gained are couched in terms of EW, the principals are broadly applicable to other mission areas.

Thursday, 0830-1000

Modeling and Simulation in Navigation System Test and Evaluation

Maj. Eileen A. Bjorkman, Commander
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The 746th Test Squadron at Holloman AFB, New Mexico, is responsible for test and evaluation of inertial navigation system (INS), Global Positioning System (GPS) navigation systems and user equipment, and integrated INS/GPS systems. In the past, most of this testing included extensive and expensive laboratory and flight testing to determine system performance and model system characteristics. These test are performed in both blue sky and jamming environments. The 746th Test Squadron recently developed a simulator, the Navigation and Evaluation facility (NavTEL) which simulates systems under test as though they were in an actual flight environment. Flight profiles can be recreated to duplicate problems seen in flight. Jamming signals can be inserted directly into the system to simulate the jamming environment. NavTEL has been used extensively to investigate navigation system anomalies reported by operational crews on C-17 and C-130 aircraft. NavTEL is a proven, versatile, simulator which can be used to minimize flight tests or eliminate them altogether. This paper will discuss NavTEL development and current configuration, several past and current test programs, and plans for the future

Emitter Location and Display Simulation (ELADS)

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Approved abstract not available at printing

WG 14 - JOINT CAMPAIGN ANALYSIS - Agenda
Chair: Richard P. Morris, McDonnell Douglas Aerospace
Cochair: Jeff Paulus, General Research Corporation
Cochair: Bill Burch, Applied Military Technologies
Advisor: James Wilmeth, SETA Corporation
Room: SNCOA – CR-1 and C&SC-228

Room: SNCOA – CR-1

Tuesday, 1030-1200
Can the US Prepare for the Next Peer Competitor? - Dr. Alan Goldman, National Ground Intelligence Center (NGIC)
Joint Scenarios for Land, Littoral and Air Warfare - Ms. Cindy Noble, TRADOC Analysis Center

Tuesday, 1330-1500
Innovative Rising Adversarial Power - Mr. Cliff Perrin, NcDonnell Douglas Aerospace
Assessing Long Range US Force Structure - Mr. Steve Ritacco, GRC Inc.

Wednesday, 0830-1000
COMPOSITE GROUP III SESSION .... Ellis Hall

Room: C&SC-228

Wednesday, 1215-1300 (Lunch Session)
Some Considerations on the Application of Soft Factors in Models and Simulations - Mr. Gerald Halbert, NGIC

Wednesday, 1330-1500
Airpower in Korea: OPLAN 5027 Campaign Analysis - Maj Russell Hodgkins, Air Force Studies and Analyses Agency
2005 Major Regional Contingency (MRC) - West Campaign Analysis - W.Dean Free, CNO Assessments Division

Wednesday, 1530-1700
Third Party Threats in a Multi-Polar World - Mr. Kyle Olsen, TASC Inc.
Employment of Weapons of Mass Destruction in an MRC Warfight - Mr. Mike Ottenberg, OSD PA&E

Thursday, 0830-1000
Land Warfare Representations in the Joint Warfare System (JWARS) - LTC Terry Prosser, JWARS Office, OSD PA&E
Joint Integrated Contingency Model, A Tool for Exploring Uncertainties in Future Military Conflicts - Dr. Dan Fox, RAND

Thursday, 1330-1500
Joint Campaign Analysis at the Naval Postgraduate School, Monterey - LCDR Eric Godat, Wayne P. Hughes, Jr., FS, NPS
Real Time Analysis for the Joint Warfighter - LTC Thomas Littlefield, USACOM, JTASC

Thursday, 1530-1700
Foreign Integrated Air Defense Systems Intelligence Analysis and Production - Mr. David Panson, NAIC
Modeling C4ISR In Uncertain Times - Maj James Knowles, DISA

WG 14 - JOINT CAMPAIGN ANALYSIS - Abstracts

Tuesday, 1030-1200
Can the U.S. Prepare for the Next Peer Competitor?

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A peer by common definition implies an equal or equivalent entity. By this definition it is unlikely that any foreign power or

entity can attain the technological prowess, military budget, training experience or power projection capabilities of the U.S. over the next two decades. Yet this paper will argue that U.S. political and military leaders might well miss the indicators of an emerging regional competitor, and thereby find themselves surprised and defeated by a major regional foreign power. The victorious power will be quickly and widely recognized not only as a superior regional power, but also as a strategic peer competitor with the ability to severely diminish the global prestige, alliances and influences of the U.S.

The greatest strategic challenge for the U.S. in the last 80 years has been to prevent the domination by any power in EURASIA, as this could constitute a threat to US vital interests. Economic and demographic trends, history, political motivation, and local opportunity suggest that China will emerge as a peer rival of the U.S. in Asia , probably by 2010. Should China choose to wage asymmetrical warfare exploiting U.S. vulnerabilities and take advantage of local geographic, demographic, and military circumstances, it could show the world that the U.S. has met its match.

Through the medium of a scenario, this paper will show how the U.S. may find itself confronted by a peer competitor which should have been obvious, but tragically catches us by surprise.

Joint Scenarios for Land, Littoral and Air Warfare

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Uncertain times and decreasing resources are creating more and more joint efforts among the services. These efforts include analytic tools such as JWARS. The Army's TRADOC Analysis Center (TRAC) is starting now in developing robust joint scenarios to support future efforts. TRAC has performed Army analyses in a joint context for numerous years. Recent efforts include the development of robust joint warfare scenarios as they support deep strike and maneuver warfare. These scenarios will incorporate deep strike, interdiction, close air support, SEAD, theater air defense as provided by naval and ground forces, amphibious operations, maneuver warfare, surveillance, reconnaissance, joint communications, support operations and coalition forces in order to analyze our capabilities in defeating threats. These scenarios incorporate smart munitions, theater missile defense attack operations and a detailed review of deployment capabilities. These scenarios provide a tool for analyzing numerous capabilities in a joint context.

Tuesday, 1330-1500

Innovative Rising Adversarial Power (IRAP)

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Many of today's weapon systems will serve well into the next century, and the generation of systems now in development may well serve to the mid-point of that century. Yet the process under which US weapons are developed still lacks a systematic means of exploring more than the first few years of the future environment in which those systems will have to perform their missions. Specifically, the two near-simultaneous MRCs planning scenario underlying OSD's FYDP and DoD's budget does not attempt to provide rationale for procurement beyond the FYDP; consequently, it cannot provide a sound basis for long term acquisition planning.

The work reported here explores a scenario further in the future than those currently being used for force planning. The report covers the results and insights derived from two wargames conducted in August and October of 1996. In those wargames, the US players sought to reverse aggression undertaken by a new and clever adversary called IRAP (short for Innovative Rising Adversarial Power). The shape of IRAP and its forces arose from the following considerations.

In addition to being today's sole superpower, the US is formally allied or informally aligned with the bulk of the world's other major military powers. Consequently, a challenge to US security interests in the 2020 timeframe would probably involve a nation outside today's major alliances. That nation's military would have to be sufficiently professional to prepare realistically and effectively for international conflict, and it would need an expanding economy in order to support that preparation without unacceptably reducing its people's economic progress. In confronting the US, such a nation could be expected to seek to counter US strengths through the application of technology and through the employment of innovative operational techniques executed by thoroughly-trained troops.

The first US-IRAP wargame, one in which innovations were not employed by IRAP, helped establish a baseline. Under those circumstances, US forces equipped only with systems now in the FYDP were able to foil IRAP's attempt to occupy a neighboring state. In the second wargame, in which IRAP was allowed to employ innovative systems and operational concepts, those same US forces could not turn the tide. It is not surprising that US planning for conflict beyond the FYDP will have to be no less innovative than that of potential foes in that timeframe, and it is therefore of concern that – despite frequent lip-service – mechanisms to introduce such innovations remain

underdeveloped.

Our aim in this and future work involving potential conflicts with IRAP is to gain insight into what kinds of challenges it would present, turning those insights into recommendations regarding development of future weapon systems and technology.

Long Range Force Planning in a Complex World

Mr. Steve Ritacco
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Long range force planning has always been fraught with uncertainty, but never to the degree that DOD is experiencing today. Far more than in the Cold War era, the development of credible assessments is hampered by multiple, potential adversaries with dispersed "flash points"; unstable alliances; rapid capability advances; and extreme technological dependencies. Our theme turns on the need for a multi-disciplinary approach to analysis – fully supported by organizational involvement across the Intelligence Community, Services, Joint Staff, and OSD.

To address uncertainty, long range planning requires a robust portfolio of information and techniques: authoritative data that can be related across functional areas; trend analysis of economics, politics, technology, and cultural features; parametric techniques to develop plausible data ranges; and methodologies that allow for consideration of "soft factors." Among analytic tools, dynamic modeling plays a key role. However, standard force-on-force, attrition based simulations -- already in declining relevance – must be replaced by more flexible, adaptive models. We will discuss the use of current simulations as well as touch on future developments in this area.

Optimizing these assets requires the participation and collaboration of experts across key organizations. Once the study director has defined the study objectives, the data analyst must work closely with the study analysts to determine the data requirements. These players join forces with the data providers from the start to develop credible data (that involves scrubbing, integrating, and analyzing myriad sources), generate a scenario, and establish the concept of operations for the U.S. and non-U.S. nations. The data release issue demands cooperation, as does the creation of alternative data positions as the providers make updates and the users iterate the CONOPS.

Through this collaborative approach, we tailor the data to particular models and techniques and provide consistent baseline positions for all applications. Thus, the study analysts spend more time analyzing the results and less time "fixing the data." In the end game, study teams can debate the merits of their analysis instead arguing over the input data. In addressing our approach, this presentation will draw heavily on our experience in supporting key DoD studies to include providing the data, developing the methodology and executing the models for the Quadrennial Defense Review.

Wednesday, 0830-1000
COMPOSITE GROUP III SESSION

Wednesday, 1215-1300
Some Considerations On The Application of Soft Factors in Models and Simulations

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In complex and uncertain times we can no longer continue to analyze possible courses of action in models and simulations without considering how human factors affect the course of battle. The intelligence community has been fairly successful at providing information to users on the composition of unit strengths, and performance characteristics of ground forces equipment. Other "soft" factors quantifying how well a country's armed forces will perform on the battle field has always been placed on the "too-hard-to-do" category.

The National Ground Intelligence Center (NGIC) has developed a methodology that evaluates factors such as morale and cohesion, readiness, leadership, training and other factors to assist in quantifying how well countries may be able to fight. In addition to the factors developed by the NGIC, other factors such as sleep loss and the effects of weather on humans can affect the ability to make rational, timely decisions on the battlefield.

The major problem with integrating "soft factors" into models and simulations is that the data bases required to draw on to develop weighting factors or other methods of portraying the effect of soft factors on the battlefield simply do not exist. Intensive dialog between the intelligence and modeling communities is required to meld conventional modeling techniques with new appraisals of enemy forces. This presentation discusses approaches being explored to improve models and simulations by including information about human factors.

Wednesday, 1330-1500
Airpower in Korea: OPLAN 5027 Campaign Analysis

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The governing plan for Combined operations in Korea is OPLAN 5027. AFSAA, in coordination with 7th Air Force and HQ Pacific Air Force, analyzed the OPLAN to gain insights into the contributions Airpower makes toward achieving the goals of the Combined Forces Commander.

This study was conducted with the THUNDER campaign model. Several key areas of emphasis were:

- The potential impact of hardened nK airfield facilities on air superiority
- The potential impact of Theater Ballistic Missiles (TBM)
- The potential success/failure of interdiction of nK follow-on forces
- The potential success/failure of Allied counter-artillery fires
- The potential success/failure of interdiction of nK supplies and logistics
- The potential impacts of nK Special Operations Forces (SOF)

The analysis was done with 1996 forces and current intelligence estimates. Potential impacts of adjusted force arrival flow were examined in a scenario where Korea was the second of two near simultaneous major regional contingencies.

2005 Major Regional Contingency (MRC) - West Campaign Analysis

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A Major Regional Contingency (MRC) - West conflict was analyzed from the joint forces perspective with a spotlight on naval forces. The scenario was based on the Defense Planning Guidance (DPG). The study objectives were to show the impact of naval forces on the land war and to provide a common campaign analysis baseline for DoN excursions and Investment Balance Review (IBR) issues. The goal was to measure the effect of different blue forces, systems and their employment on the outcome of the conflict. Warfighting effectiveness was measured in terms of force generation/access to theater, blue losses and ground war results.

Various modeling tools, including the General Campaign Analysis Model (GCAM), battlespace dominance/logistics models, the Integrated Theater Engagement Model (ITEM) and TACWAR were used to assess ground, sea, undersea, air, and amphibious operations at a suitable level of resolution to determine programmatic payoffs. The briefing will include a GCAM animation of a large, complex amphibious operation.

This briefing will describe baseline results. It will also address lessons learned as a result of integrating diverse models to support the analysis, and the application of current technology to automate the integration process. The product represents the work of the N812D staff, and personnel from Systems Planning and Analysis, Inc., and SAIC.

Wednesday, 1530-1700

Third Party Threats In a Multi-Polar World

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In the years since the Gulf War, the arguments have been made that chemical and biological weapons (CBW) should not be viewed as equivalent to nuclear weapons, and that modern conventional capabilities are a very effective counterbalance. But what happens in the event of a successful chem or bio attack against a nuclear power which does not enjoy the American luxury of overwhelming conventional forces? The potential use of CBW in this context poses dramatic, unanswered security questions for the United States.

In the aftermath of a moderately effective CBW attack (10-50,000 fatalities), any foreign government would be under tremendous pressure to respond with maximum force, the goal being to inflict disproportionately heavy casualties on the attacker. For a wounded nation's people and leaders, even nuclear retaliation could be justified militarily, politically, and morally.

Depending on the scenario, Washington would be forced to choose among several equally unattractive responses, each with profound political and military consequences:

1. Diplomatic intervention, in a probably ineffective effort to reach a peaceful resolution.
2. Military assistance/intervention, leading US conventional forces to a punitive action against the aggressor as a hedge against a nuclear response.
3. Hands off, essentially sanctioning a nuclear response.
4. Unilateral US "police action."

There is a clear need to reassess the potential threat of CBW from other than an America-centric perspective. The domino effect of a WMD use against a nuclear or near-nuclear state represents a significant, unstudied element in the international security equation.

Employment of Weapons of Mass Destruction in an MRC Warfight

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Threat countries may employ Weapons of Mass Destruction (WMD) to provide the combat power required to defeat US and Allied forces in future contingencies. What risks do WMD place on US force structure, strategic mobility, and modernization programs within the context of a nearly-simultaneous dual MRC set of contingencies? Moreover, how should US medical components be structured and supplied to respond to potential WMD usage?

The briefing describes how the Simulation and Analysis Center (SAC) – as a member of the Joint Collaborative WMD Analysis (JCAC) effort co-chaired by J-8 and J-4 – analyzed US force sufficiency and capability issues in a Weapons of Mass Destruction environment. In particular, this effort determined the warfighting risks associated with threat employment of lethal chemical weapons in an MRC warfight. Answers to these issues will support analysis of long term recapitalization issues – particularly in the areas of tactical missile and chemical defenses as well as counter-SSM assets. Force structure and modernization issues will contribute to on-going defense reviews. In addition, the study improves the analytical community's tools by validating upgraded theater models – TACWAR – for WMD analyses. The analysis was conducted for the Theater Assessment and Planning (TA&P) Deputate and forms the OSD PA&E portion of the Joint Collaborative WMD Analysis.

<u>*Thursday, 0830-1000*</u>
Land Warfare Representations in the Joint Warfare System (JWARS)

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The department of defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

Land warfare is an area of primary focus in the JWARS project. Areas of interest include movement, doctrine and tactics, including maneuver warfare, engagements and attrition, and the impact of information operations on battle outcomes. This presentation will discuss the land warfare representations in the JWARS testbed and the lessons learned in developing the testbed. A portion of the testbed discussion will deal with representations of perception vs ground truth. The presentation will also discuss future directions for land warfare functionality in production versions of JWARS.

Joint Integrated Contingency Model, A Tool for Exploring Uncertainties in Future Military Conflicts

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The Joint Integrated Contingency Model (JICM) is a global war gaming and analysis tool developed within RAND and sponsored by OSD/Net Assessment. The model provides an aggregated, theater-level combat representation that integrates strategic deployment by air and sea, ground, air, and naval warfare, ballistic missile and ballistic missile defense, as well as strategic target attack. The model had been enhanced by additions to the interface language permitting the analyst to create analytical war plans which can respond to changes in the simulated operational environment as well as add model extensions which effect specific adjudicated outcomes based on intermediate simulation results. Because of speed of execution, typically several days of combat per minute of wall clock time, the model is particularly suited for examining a variety of input conditions or parametric studies of large number of variables. This briefing describes the JICM and recent model enhancements and discusses how the model has been used in some recent studies.

Thursday, 1330-1500

Joint Campaign Analysis at the Naval Postgraduate School, Monterey

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Joint Campaign Analysis is the capstone military course of the Naval Postgraduate School's Operations Research Curriculum. The goal of this course is to teach students the levels of warfare and the role of the Joint Campaign Analyst. Students are given an understanding of the operational/theater level of war and its key position as the interface between tactical and strategic levels of war. The joint military campaigns studied cover Land, Sea and Air warfare cases. Each case is defined by the course lecturers as part "Art of War" backed with a quantitative "Science of War" analytic approach. Participation as a high level staff analyst for individual and team scenarios are provided. This stimulates the thought process required for a Pentagon/CINC "overnight analysis".

This course was designed for DOD and International students interweaving the final year of graduate education with respective military backgrounds. Students of all DOD services come from both the Operations Research and National Security Affairs Curriculums. This unique blend enriches both types of officers with the understanding of what quantitative analysts and policy analysts bring together when assembled as a team for executive decision briefs.

Presentation will show the course content and design. Example briefings from student teams are noted and the student text will be available. This course is designed by CAPT Wayne P. Hughes, USN (Ret) and taught by himself, Professor Sam Parry, and LCDR Eric Godat.

Real Time Analysis for the Joint Warfighter

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The roots of operations analysis go back to World War II where analytic results contributed to military successes such as the Air Battle of Britain, the Island Campaign in the Pacific, and the Battle of the North Atlantic. Today we continue this legacy by providing analytic support to joint planners, primarily during their deliberate planning cycles. There is also a need to provide analytic support during crisis action planning. In fact, as soon as a deliberate plan is pulled off the shelf for execution, the crisis action planing process begins. Planners have to produce a viable plan in an intense and time critical environment. The purpose of this presentation is to demonstrate an approach for providing real time analysis to the joint warfighter. We found that the process is more important than the analytic tool. This process is based upon tearing down the wall that exists between the operator and the analyst. This is done by building credibility with the operator, understanding his requirements, and providing analytic results that fit into his battle rhythm. Typically, results must be turned around within a three to six hour period. Anything slower is often a wasted effort, decisions will be made with or without analytic results. This presentation doesn't provide all the answers; however, it provides the insights and approaches that have evolved in the Analysis Branch at the United States Atlantic Command during support provided to the Unified Endeavor exercises and an actual contingency.

Thursday, 1530-1700

Foreign Integrated Air Defense Systems Intelligence Analysis and Production

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This presentation will discuss the new DoD IADS Support Program (DODISP) and how a new team has been formed to pool resources from several organizations to conduct IADS intelligence analysis and production. This approach eliminates redundancy and allows for a single point of contact for foreign 'big picture' IADS intelligence, namely MAIC/GTI. To further help stretch resources NAIC/GTI is pioneering a new virtual production effort to bring the various team members together in a virtual environment to facilitate intelligence production electronically. IADS products are becoming paperless with a push towards total visualization techniques to illustrate the IADS, using point and click techniques to bring up details. Visualization will go hand in hand with modeling and simulation efforts beginning to take shape in GTI.

Modeling and simulation will play a key role in the analysis of foreign IADS. NAIC hopes to leverage off existing simulation tools with wide community acceptance as well as developing and new tools that are required. Simulations may include integrating existing proven models into the simulation/visualization. The user will be able to play as an interactive participant at any point in the IADS. This could be from a pilots point of view inside the cockpit as he flies into an enemy IADS, to a radar operator on the ground watching his radar scope.

Modeling and simulation techniques will have to be flexible enough so that any type of IADS can be modeled quickly since it will be unrealistic to have an IADS model on the shelf for every country. As new IADS technologies evolve the simulations will also have to be able to adapt in order to provide accurate representations. We also hope to use our IADS models as customer products that can be combined and used with the customers own models and simulations where threat IADS modeling is required.

Modeling C4ISR In Uncertain Times

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The Defense Information System Agency (DISA) initiated the development of a Joint Command, Control, Communication, and Computer (C4) Intelligence, Surveillance, and Reconnaissance (ISR) Model in June of 1995. The revolution in military affairs and the recognition of the potential for Dominant Battlefield Awareness required a tool to demonstrate that value of information and the information infrastructure (C4 Domain). DISA assumed a leadership role in C4 modeling in an effort to understand the impact of information flow on decision making. The development of the DISA C4ISR Model took a federated approach using Commercial off the Shelf (COTS) and Government off the Shelf (GOTS) tools. In February 1996, Defense Modeling and Simulation Office (DMSO) authorized the C4ISR Model to use the Run Time Infrastructure (RTI) from the High Level Architecture (HLA). Approval as a prototype federation for the C4 Domain stemmed from the DISA examination of C4ISR matters for the Joint Warfare System (JWARS) and Joint Simulation System (JSIMS). An important aspect to the C4ISR Model is the use of information objects and examination of decision making made within a Common Operational Picture (COP). The model also incorporates Information Warfare elements to begin modeling and understanding this very complex subject. The creation of information objects provides an avenue for analysis on how information and Information Warfare events impact the decision making process on the outcome of conflict or on Operations Other Than War (OOTW).

WG 15 - COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, INTELLIGENCE, SURVEILLENCE, AND RECONNAISSANCE (C4ISR) - Agenda

Chair: MAJ ROBERT A. CLAFLIN, US Army TRADOC Analysis Center (TRAC)
Cochair: LTC Pat Vye, Joint Staff
Cochair: Mr. John Brand, Army Research Lab
Cochair: LT Jim Dettbarn, Operational Test and Evaluation Force (COMOPTEVFOR)
Cochair: Mr. John Grossman, RAND
Advisor: Mr. Donald Kroening, US Army TRADOC Analysis Center (TRAC)
Room: Diamond Hall – CR-5 and MCRC – CR-164

Room: Diamond Hall – CR-5

Tuesday, 1030-1100
Contribution of C4ISR Systems to the Joint Close Support Mission Area
Mr. Patrick G. Smock, Operations Research Analyst, USA TRAC

Tuesday, 1100-1130
Campaign Utility of Information Systems - Part I and II
LTC Ronald L. Graves, System Engineering & Integration Space & Missile Center

Tuesday, 1130-1200
Campaign Utility of Information Systems - Part I and II
Dr. Robert Reid, Jr., Senior Engineering Specialist, The Aerospace Corporation

Tuesday, 1330-1500
COMPOSITE GROUP IV SESSION .... Ellis Hall

Room: MCRC – CR-164

Wednesday, 0830-0900
Reducing Fratricide: BCIS, 2nd GEN FLIR, and Situational Awareness Trade-Off Study Using Groundwars
Mr. Gary Comstock, U.S. Army Materiel Systems Analysis Activity

Wednesday, 0900-0930
Determining Sensor Requirements for Battle Damage Assessments
Capt Jeffrey Weir and Maj Mark Gallagher, United States Strategic Command

Wednesday, 0930-1000
Why Aren't Mission Threads Good Enough?
Ms. Ann Brodeen, US Army Research Laboratory

Wednesday, 1330-1400
Adaptive Architectures For Command And Control (A2c2) The Second Experiment
Prof. William G. Kemple, Naval Postgraduate School

Wednesday, 1430-1500
Rapid Force Projection Initiative C3 Architecture Study
Mr. Chauncy McKearn, Hughes Aircraft Company

Wednesday, 1530-1600
Virtual Reality Combat Network Battle Management and Analysis Tool
Dr. John Brand, Army Research Laboratory and John Nichols, Quality Research Inc.

Wednesday, 1600-1630
Foreign Integrated Air Defense Systems Intelligence Analysis and Production
Mr. Dave Panson, National Air Intelligence Center

Thursday, 0830-0900
Sensor-to-Shooter III Systems Analysis and Modeling approach
LTC Patrick Vye, The Joint Staff, J6, The Pentagon

Thursday, 0900-0930
Intelligence Fusion in the JWARS Prototype
LTC Terry W. Prosser, Office of the Secretary of Defense

Thursday, 0930-1000
Joint Virtual Laboratory (JVL)
Mr. Howard Haeker, USA TRAC

Thursday, 1330-1400
Modified "Lamp" Analysis Of Computer-Related Information Warfare
Mr. John Coale, Defense Intelligence Agency

Thursday, 1400-1430
Russian Views Of Information Warfare
Mr. John Coale, Defense Intelligence Agency

Thursday, 1430-1500
Indications And Warning For Computer-Related Information Warfare
Mr. John Coale, Defense Intelligence Agency

Thursday, 1530-1600
Reconnaissance Architecture Synthesis Model (RASM)
Mr. Doug Brouse, Science Applications International Corporation (SAIC)

Thursday, 1600-1630
Modeling C4ISR in Uncertain Times
Major James Knowles, DISA

WG 15 - COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, INTELLIGENCE, SURVEILLENCE, AND RECONNAISSANCE (C4ISR) - Abstracts

Tuesday, 1030-1100
Contribution of C4ISR Systems to the Joint Close Support Mission Area

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The Close Support End-to-End Assessment is being conducted for the Joint Staff by the TRADOC Analysis Center. The purpose of the assessment is to identify effective mixes of capabilities, systems, munitions, and linkages that maximize the commander's combat power for the close support mission area. One of the objectives of the assessment is to identify improvements required in C4ISR to achieve greater efficiency and responsiveness to the ground commander's immediate firepower support needs.

This paper will focus on the methodology used to examine contributions of various C4ISR systems to close support, including modeling and simulation tools and measures of effectiveness; and will also present summary results from the C4ISR portion of the assessment.

Tuesday, 1100-1130
Campaign Utility of Information Systems - Part I

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For M&S to become a greater factor in DoD force structure planning & investment decisions, defense operations analysts across the multiple services, agencies and contractor organizations must bring their models into alignment with a common language and conceptual framework. Only then can we compare analytic results of different models and derive increased confidence either from corroboration or from discovery and reconstruction of defective combat process representations.

Organizations involved in development of military space systems and, more generally, those developing C4ISR systems have a critical need to understand which performance variables and threshold levels of achievement have the greatest effect on projection of military power. While the next generation of Joint Warfare models currently will conform to legislated standards of syntax and semantics, there is an interim when improvements to current combat models, especially QRA models, can make a significant contribution to military utility analysis. During this period we propose a framework to challenge the analytic marketplace voluntarily to continue convergence to a consistent, hierarchical representation of joint military operations connecting operational MOEs to engineering MOPs.

The proposed framework can be viewed as an integration of those conceptual domains of military operations analysis which already have gained a large market share. A Strategy-to-Task hierarchy of 4-5 levels is regarded as sufficient to correlate generically with service OPLANS and to interface comprehensibly with system engineering models spanning that functional spectrum often described as the "OODA loop" (Observe, Orient, Decide, Act). This unified structure permits a clear, quantitative transformation from system MOPs into attrition-based MOEs which can be rolled-up from killer-victim scoreboards through ground, sea, air & space campaign objectives into an overall campaign Measure of Utility (MOU). This approach should work equally well for teach of the basic combat model types--word, math, simulation--discussed by C. Ancker, Jr. in "A Proposed Foundation for a Theory of Combat," found in *Warfare Modeling*, MORS, 1995. A subset of the framework has been demonstrated in operation with a system dynamic math model using a notional peer competitor scenario and this work is described in Campaign Utility of Information Systems--Part II.

Tuesday, 1130-1200
Campaign Utility of Information Systems - Part II

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In determining the need for future military space systems, one would like to proceed in an objective manner which relates space system performance to larger military objectives. The justification for a particular system is sought in the bottom-line value it provides to actual military operations.

Toward this end, an analysis process is described which links space system performance to military effectiveness at a campaign level of conflict. This process, which is described in Campaign Utility of Information Systems - Part I, is a framework for combining campaign objectives, modeling and simulation tools, and representative scenarios into a unified analysis structure.

The principal elements of the framework include a campaign operational task flow, a campaign math model, a metric roll-up methodology, campaign scenarios, and a procedure for assessing performance sensitivities and determining system requirements. The campaign math model used in this description of the process is the System Utility Math Model (SUMM) which was derived to complement the framework and to illustrate the methodolgy for a specific campaign scenario. The SUMM tool represents campaign force elements in aggregated fashion. The attrition of opposing force elements is the result of engagement interaction. This tool characterizes engagement effectiveness via a matrix structure which accounts for battle tempo, force access, and force efficiency. The SUMM tool is a planning aid which is intended to interface with larger campaign simulatuions working at the micro-shooter level. Both the framework process and the SUMM tool are applied to the sample scenario as a means of exposition.

Tuesday, 1330-1500
COMPOSITE GROUP IV SESSION

Wednesday, 0830-0900
Reducing Fratricide: BCIS, 2nd GEN FLIR, and Situational Awareness Trade-Off Study Using Groundwars

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This study investigated contributions of anti-fratricidal technologies using the Groundwars combat simulation model. Technologies addressed were Second- Generation Forward Looking Infrared (FLIR), Battlefield Combat Identification System (BCIS), and Situational Awareness (SA). Target mis-identification was also investigated. This study examined reduction of fratricide as well as the increase in force effectiveness when employing anti-fratricidal technologies. The study looked at the following combat conditions:

Condition 1: Mis-identification of targets not possible; Blue had good knowledge of Blue locations (i.e., Blue rarely engaged Blue, usually engaged Red);
Condition 2: Mis-identification of targets not possible; Blue had uncertain knowledge of Blue locations (i.e., Blue sometimes engaged Blue, disengaged Red);
Condition 3: Mis-identification of targets possible; Blue had good knowledge of Blue locations; and
Condition 4: Mis-identification of targets possible; Blue had uncertain knowledge of Blue locations.

Blue would fire on classification. Second-Generation FLIR anti-fratricidal technology option required firing on identification only. Study results showed for the zero mis-identification condition, BCIS provided significant contribution to Blue using First-Generation FLIR. When Blue employed Second-Generation FLIR, all technology options (i.e., FLIR, BCIS, and SA) increased Blue effectiveness equally. For the case where target mis-identification was possible, BCIS provided the most significant reduction of fratricide and increase in Blue effectiveness.

Wednesday, 0900-0930
Determining Sensor Requirements for Battle Damage Assessments

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The value of Battle Damage Assessment (BDA) is the ability to determine whether restrike is required against a target or not. Therefore, we recommend determining sensor specifications to support BDA based on the sensor ability to provide useful information. Weapons effect uncertainty and weapon delivery accuracy are the two sources of uncertainty which cause difficulty in determining battle damage. The weapons effects are a function of the interaction between the target vulnerabilities and attack weapon capabilities. Thus, weapon effects are fixed for any assigned weapon against a specific target. A sensor can reduce the uncertainty caused by not knowing the location of the actual weapon impact.

We describe how the information from a sensor can be incorporated to improving the probability of damage estimates. We model weapon delivery accuracy and sensor accuracy as bivariate Gaussian distributions. First, we show the distribution of potential impacts points can be updated based on sensor data using a Kalman filter update stage. Then, we incorporate the updated distribution into the probability of damage equation.

We apply a battle damage criterion to classify the target as destroyed or requiring a restrike. We can equivalently state this criterion in terms of probability of damage with gp or in terms of range from the target with gr. We can think of our decision criterion as a hypothesis test. The null hypothesis is that the target damage to the specified level and the alternative hypothesis is that the target did not sustain sufficient damage and a restrike is required:

Ho: Target damage to desired level (no restrike required) Ha: Insufficient damage to the target (restrike required)

As in a hypothesis test, two types of errors exists. Type I error concludes Ha when Ho is true. In this application, a Type I error is reporting the damage is not destroyed when it actually is destroyed. A Type error would lead to needlessly restriking a destroyed target. A Type II error concludes Ho when Ha is actually true. In this application, a Type II error is reporting the target as destroyed when in actually the target should be retargeted.

Given the above structure, we can evaluate battle damage assessment for various sensor accuracies. The analysis requires an assignment of weapons against specific targets. Sufficient information must be provided to determine the probability of damage at any given impact range, the aimpoint offset, weapon accuracy, and sensor accuracy. The criterion at each sensor accuracy was selected to achieve that desired confidence level after averaging across all the weapon to target assignments.

Wednesday, 0930-1000

Why Aren't Mission Threads Good Enough?

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For many years military command and control systems have been evaluated by the use of mission threads. Mission threads arise from operational requirements and are designed so that a system's response to a series of selected scenario events can be quantified. They may be used to answer timeline and routing questions such as: "How long does it take to complete a mission?", "How can information be more effectively routed?", or "Where are the delays in the mission threads occurring?". While this descriptive data is sufficient for the decision maker to judge a prototype command and control system on a pass/fail basis, it does not convey information about the performance of the communications system; in particular, it does not allow the accurate determination of throughput and delays. Mission threads do not allow human effects to be satisfactorily decoupled from the communications effects, thereby inhibiting the characterization of the types of delays a system may be experiencing. An in-house solution has been to generate "messages" that are simply character strings of a specified length and arrival rate. Test and evaluation software inserts the message strings into the communications system, and allows network statistics to be made accessible to the decision maker in an accurate and timely fashion. This paper describes the nature of mission threads, problems encountered with their use, and the effective use of message strings in simulation and experimentation.

Wednesday, 1330-1400
Adaptive Architectures For Command And Control (A2C2) The Second Experiment

William G. Kemple, Naval Postgraduate School
James Drake, Naval Postgraduate School
Gary R. Porter, Naval Postgraduate School
David L. Kleinman, University of Connecticut, Storrs, CT
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A basic premise of the A2C2 project is that organizational structure should somehow "match" the available resources to the mission (task structure), and that changes to the resources available or the task structure should in turn induce changes to the organizational structure. In an attempt to examine this and other basic hypotheses, A2C2 researchers are using an analytic-empirical approach to conduct model-driven experiments with human organizations.

This talk describes the second A2C2 experiment, conducted in November 1996 at NPS. Two distinct initial organizational structures were used: a model-based organization designed to minimize coordination demands, and a traditional military organization. They differed in both command and resource structure. Both had the same total mix of assets, a common, global information structure and open communications.

The experiment was conducted in three stages by six teams, three teams in the model-designed organization, and three traditional. In stage 1, the scenario was played and the teams were asked identify any shortcomings and to re-design their organization. Stages 2 and 3 were pencil-and-paper studies designed to explore adaptation. Each team responded to two trigger vignettes. In one, the team had to perform its mission with about one-half of the original assets. In the other, they had to perform a NEO in addition to their original mission. The players were asked to redesign the command and asset structures, if appropriate, and in the second vignette, to develop a task graph of the activities required by the expanded mission.

Wednesday, 1430-1500
Rapid Force Projection Initiative C3 Architecture Study - Approved abstract not available at printing.

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Wednesday, 1530-1600
Virtual Reality Combat Network Battle Management and Analysis Tool

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The Army Research Laboratory (ARL) is charged with basic research in defensive information warfare. Part of this responsibility involves network management under combat conditions. A virtual reality network management and analysis tool inspired by a tool reported initially by British Telecom, is being developed for ARL under a Small Business Innovative Research (SBIR) contract by Quality Research, Inc. The tool, the Virtual Reality C3 Net Management Tool, acts as a data management and display device, acquiring information on net status in a variety of ways, processing the network status information, and displaying it in a two-dimensional planform, superimposed on digitized three-dimensional map data, perspective view from a steerable viewpoint, or in three-dimensional color, real-time virtual reality, using display goggles. This will allow management of a net in a real time and post-battle or post-exercise analysis of net performance.

The program is based on commercial virtual reality tools. The data can be acquired by "eavesdroppng" on an internet/ethernet, by acquiring data from the status reports broadcasted in a distributed information simulation, or by using common network management protocols. The status of the units simulated during a Distributed Interactive Simulation (DIS) environment wargame, or the status of the DSI net itself, may be deduced and displayed in real time or battle time, or stored and played back for later analysis. Net status information may ultimately be derived from interactive simulations such as ModSAF.

The phase I effort will concentrate on construction of the virtual reality tool, display, and data gathering and miniulation modules. The action will be driven by scripts. The University of Alabama (Huntsville) will provide consulting expertise in virtual reality, and GTE will provide expertise in combat nets.

Wednesday, 1600-1630
Foreign Integrated Air Defense Systems Intelligence Analysis and Production

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This presentation will discuss the new DoD IADS Support Program (DODISP) and how a new team has been formed to pool resources from several organizations to conduct IADS intelligence analysis and production. This approach eliminates redundacy and allows for a single point of contact for foreign "big picture" IADS intelligence, namely NAIC/GTI. To further help stretch resources NAIC/GTI is pioneering a new virtual production effort to bring the various team members together in a virtual environment to facilitate intelligence production electronically. IADS products are becoming paperless with a push towards total visualization techniques to illustrate the IADS, using point and click techniques to bring up details. Visualization will go hand in hand with modeling and simulation efforts beginning to take shape in GTI.

Modeling and simulation will play a key role in the analysis of foreign IADS. NAIC hopes to leverage off existing simulation tools with wide community acceptance as well as developing new tools that are required. Simulations may include integrating existing proven models into the simulation. Eventually NAIC hopes to have a completely interactive IADS simulation/visualization. The user will be able to play as an interactive participant at any point in the IADS. This could be from a pilots point of view inside the cockpit as he flys into an enemy IADS, to a radar operator on the ground watching his radar scope.

Modeling and simulation techniques will have to be flexible enough so that any type of IADS can be modeled quickly since it will be unrealistic to have an IADS model on the shelf for every country. As new IADS technologies evlove the simulations will also have to be able to adapt in order to provide accurate representations. We also hope to use our IADS models as customer products that can be combined and used with the customers own models and simulations where threat IADS modeling is required.

Thursday, 0830-0900
Sensor-to-Shooter III Systems Analysis and Modeling approach

LTC Patrick Vye, Deputy Study leader
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The Sensor-to-shooter III study was a J6/Decision Support Center (DSC) study conducted June 96 through April 97. This study culminated in a briefing to the Joint Requirements Oversight Council (JROC). The purpose of the study was to begin to define the communication paths (joint links) that support joint precision engagement in the strike, defense and maneuver mission areas by 2010. The study was a "quick turn around" study that examined six different Operational Situations (OPSITS) aimed at improving joint interoperability and improved weapons performance through "joint" links. These OPSITS included: (1) Suppression of enemy air defenses (2) Close air support (3) Precision strike (4) Theater air defense (Cruise missile) (5) Brigade/Regiment deliberate attack and (6) Operational maneuver from the sea. The purpose of this presentation is to discuss a few representative OPSITS and discuss the systems analysis and study methodology that was used. Specific modeling techniques and approaches are discussed.

Thursday, 0900-0930
Intelligence Fusion in the JWARS Prototype

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The department of defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

A central development objective for JWARS is the representation of perceived battlespace truth, or perception. Perception of enemy activities, and how that perception feeds the command and control decision process, was a fundamental focus of the JWARS prototype. This presentation discusses the design, techniques and algorithms employed in the JWARS prototype to represent the intelligence fusion process. It also discusses how synthetic forces use that perception to affect battle management decisions within the prototype. The presentation will end with a discussion of how the JWARS Office plans to address this critical functionality in initial production versions of JWARS.

Thursday, 0930-1000
Joint Virtual Laboratory (JVL)

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The JVL is a facility which provides synthetic environments for DoD component use in analysis and in support of operations. Army tactical C2 systems (e.g. MCS, ASAS, etc,) are linked with virtual and constructive simulations (e.g. ModSAF, Eagle, etc.) using the high-level architecture. The three main objectives for the JVL are:

1) Provide environment for man-in-the-loop use of C4I in analysis and evaluation of new concepts.
2) Provide active element to augment Advanced Warfighting Experiments (AWEs) and AdvancedTechnology emonstrations (ATDs).
3) Provide environment to support the development of High-Level Architecture (HLA) and advanced software concepts.

This paper will provide a description of the concept of operations and past results, near term efforts and future use of the JVL by TRAC, Army, DoD and the private sector/industry.

Thursday, 1330-1400
Modified "Lamp" Analysis Of Computer-Related Information Warfare

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Defense Intelligence Agency
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The growing use and dependency on computer systems in the Department of Defense has creAted new security vulnerabilities. Using the Lockwood Analytical Method for Prediction (LAMP), specific Russian scenarios and alternate futures involving foreign offensive Information Warfare against the U.S. military were analyzed. Conclusions from this analysis provide recommendations for improving Intelligence Community support to the National Military Strategy.

Thursday, 1400-1430
Russian Views Of Information Warfare

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Since U.S. national decision makers require better knowledge of defensive issues, current Russian views on their potential use of offensive Information Warfare against the U.S. military are examined. This type of changing Third Wave warfare demands understanding to formulate plans, policies, and directives for the security and protection of C4I operations.

Thursday, 1430-1500
Indications And Warning For Computer-Related Information Warfare

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The growing use and dependency on computer systems in the Department of Defense has created potentially new security vulnerabilities. Since U.S. national decision makers require the best intelligence possible to settle global, regional, and national issues, the development of plans, policies, and directives for the security and protection of computer operations and information is necessary. By examining several potential Information Warfare scenarios against the U.S. military, recommendations and guidance can be provided for improving the Indications and Warning system.

Thursday, 1530-1600
Reconnaissance Architecture Synthesis Model (RASM)

Mr. Doug Brouse
Science Applications International Corporation (SAIC)
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RASM is a stand-alone constructive architecture-level optimization model designed to solve for the most cost effective mix of reconnaissance assets to meet the collection requirements of a major regional conflict. Inputs to RASM include an aggregated description of the target laydown, description of alternative reconnaissance vehicles and on-board sensors, and an aggregated description of the reconnaissance requirements in theater. RASM models the effects of sensor FOV, range limits, imaging time, effects of mean distance

between targets, platform speed and altitude, and standoff distance. Terrain obscuration is modeled based on DTED. The model accounts for reconnaissance bonusing whereby multiple targets may be found in a single image or multiple requirements may be satisfied by a single image. The model allows for a trade-off between the number of images required and their quality. Costs are based on life cycle costs for each platform including both acquisition and O&S. Both length of conflict and attrition effects are included. Constraints can be imposed which require a balance between the requirements satisfaction for component commanders, across areas, and battle phase. The model uses the revised simplex algorithm to solve a 5,000 variable, 500 constraint linear programming problem. Run times are typically under one minute using a Sun Sparc 20. Outputs include the optimal mix of platforms, their sensor allocation, and requirements satisfaction by area and component commander. The model can automatically solve sequences of runs producing pareto curves, sensitivities on all 1200 input values, or varying satisfaction of requirements.

Thursday, 1600-1630
Modeling C4ISR in Uncertain Times

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The Defense Information System Agency (DISA) initiated the development of a Joint Command, Control, Communication, and Computer (C4) Intelligence, Surveillance, and Reconnaissance (ISR) Model in June of 1995. The revolution in Military Affairs and the recognition of the potential for Dominant Battlefield Awareness required a tool to demonstrate the value of information and the information infrastructure (C4 Domain). DISA assumed a leadership role in C4 modeling in an effort to understand the impact of information flow on decision making. The development of the DISA C4ISR Model took a federated approach using Commercial off the Shelf (COTS) and Government off the Shelf (GOTS) tools. In February 1996, Defense Modeling and Simulation Office (DMSO) authorized the C4ISR Model to use the Run Time Infrastructure (RTI) from the High Level Architecture (HLA). Approval as a prototype federation for the C4 Domain stemmed from the DISA examination of C4ISR matters for the Joint Warfare System (JWARS) and Joint Simulation System (JSIMS). An important aspect to the C4ISR Model is the use of information objects and examination of decision making made within a Common Operational Picture (COP). The model also incorporates Information Warfare elements to begin modeling and understanding this very complex subject. The creation of information objects provides an avenue for analysis on how information and Information Warfare events impact the decision making process on the outcome of conflict or on Operations Other than War (OOTW).

WG 16 – MILITARY ENVIRONMENTAL FACTORS - Agenda

Chair: Ms. Eleanor Anne Schroeder, Ocean Executive Agent Office
Cochair: Dr. Theodore "Ted" Bennett, Naval Oceanographic Office
Cochair: Mr. Thomas Piwowar, Science and Technology Corporation
Cochair: Mr. Warren Olson, Institute for Defense Analysis
Cochair: Dr. Peter Chu, Naval Postgraduate School
Advisor: Mr. Stan Grigsby, EPS
Room: Diamond Hall – CR-1 and C&SC – CR-145

Room: Diamond Hall – CR-1

Tuesday, 1030-1200
The Master Environmental Library: The Status of Your Online Gateway to Environmental Information
Dr. Fred C. Newman, Johns Hopkins University, Applied Physics Laboratory

The NAVOCEANO Strategic Management Model
Dr. Theodore "Ted" Bennett, Naval Oceanographic Office

Tuesday, 1330 – 1500
COMPOSITE GROUP IV SESSION .... Ellis Hall

Wednesday, 0830-1000
Advanced Technologies for Assessing the Impact of Oceanographic Environment on Military Operations
Dave Pitcher, USSOCOM

Requirements for an Urban Structure Digital Database to Support the Antiterrorism (AT) Planner
Philip Doiron, Applied Research Associates, Inc.

Room: C&SC – CR-145

Wednesday, 1330-1500
MCM/METOC Tactical Applications
Lisa Turbidy, Coastal Systems Station

Impact of the Littoral Environment on Minehunting Operations
Steve Haeger, Naval Oceanographic Office

Wednesday, 1515-1645
Environmental Effect on Mine Countermeasures
Dr. Peter Chu, Naval Postgraduate School

Forecasting River Stages World-Wide
Dr. William Martin, USAE Waterways Experiment Station

Thursday, 0830-1000
IPB Process Value Added via Computer-Aided Procedures: Methodology and Results
Mr. Jeffery Williamson, USAE Waterways Experiment Station

Assessment of Mobility Performance within CCTT
Dr. Niki Deliman, USAE Waterways Experiment Station

Thursday, 1330-1500
Littoral Metorological/Oceanographic (METOC) Tactics
Tom Little, Sea-based Weapons and Advanced Tactics School (SWATS)

WG 16 - MILITARY ENVIRONMENTAL FACTORS - Abstracts

<u>*Tuesday, 1030-1200*</u>

The Master Environmental Library: The Status of Your Online Gateway to Environmental Information

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The Master Environmental Library (MEL) is being developed by the Defense Modeling and Simulation Office as an online resource of global environmental information to support representation of the natural environment in advanced computer simulations and to support the national decision maker and the warfighter. The MEL is an internet-based system providing the user a single point of access through a powerful HTML or JAVA interface to a growing number of geographically distinct sites possessing environmental information, data, and products. The MEL facilitates discovery, access, subscription, and delivery through a single interface to meet the user's environmental requirements. Access to classified data via MEL will be available in the near future. The MEL Program is currently investigating opportunities and making plans for transition to long term operational status.

The NAVOCEANO Strategic Management Model

Dr. Theodore "Ted" Bennett
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The Naval Oceanographic Office (NAVOCEANO), working within the Naval Meteorology and Oceanography Command, is the U.S. Navy's production center for oceanographic data used to build Oceanographic and Global Geospatial Information and Services (GGI&S) products and services. Its Strategic Management Model consists of:

- a Strategic Plan that sets the long-term goals, strategies, and objectives of NAVOCEANO and maps how to realize them
- a suite of metrics and an assessment plan to measure NAVOCEANO's progress toward realizing its Strategic Plan
- an evaluation of the outcome of NAVOCEANO goals, products and services

The purpose of this Model is to maximize the relevance, responsiveness, and cost effectiveness of NAVOCEANO to its customers. It embraces the Government Performance and Results Act (GPRA) and Department of the Navy policy regarding the use of metrics. This Model is a living Model that continues to evolve with time.

Management and technical personnel conducted a series of off-site meetings to develop the Strategic Plan. All NAVOCEANO personnel were solicited for input to the Plan and several vision groups supplemented the long-range vision of the initial Plan. The Plan calls for the establishment of metrics to assess all critical processes within NAVOCEANO. In addition, NAVOCEANO projects and programs will be continually evaluated using a balanced scorecard that considers the programs and projects from such perspectives as the customer base, the growth potential of the technology, and the potential for outsourcing. Analysis of these notional metrics from a balanced suite of perspectives rather than a single perspective provides the basis for top management to allocate resources and adjust the NAVOCEANO product line in an optimal manner. An aggressive customer liaison effort, exercise reconstruction and analysis, and wargaming provide estimates of the outcomes of warfare scenarios supported by NAVOCEANO Oceanographic and GGI&S products and services.

Much of the exercise analysis and wargaming is done in collaboration with external organizations. NAVOCEANO welcomes additional collaborations with the operations research community that will help predict the impact of oceanographic and GGI&S products on naval and joint operations.

<u>*Wednesday, 0830 - 1000*</u>

Advanced Technologies for Assessing the Impact of Oceanographic Environment on Military Operations

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Accurate and timely oceanographic information characterizing the natural, physical environment is vital to the successful

conduct of military operations. This information is factored into the decision-making process to determine the impact on operations (i.e., vulnerabilities, tactical advantages, safety, etc.) and to ensure that actions are planned effectively and executed successfully. Environmental conditions can serve as cover or as an impediment to operations. Exploiting knowledge of environmental conditions acts as a force multiplier, increasing the probability of success for a particular mission.

This paper highlights innovative and advanced technologies that enable the incorporation of oceanographic environmental parameters and effects into the systems used by military analysts and on-scene commanders. A review of the oceanographic essential elements of information (EEIs) required to support littoral warfare operations is presented. A survey of current and future technologies which address these oceanographic EEIs is provided. Technological areas focused on include remote sensing systems (multi- and hyperspectral satellites, autonomous undersea and aerial vehicles), advanced data processing algorithms, collaborative development initiatives (data fusion), and digital dissemination systems. Issues associated with support to mission planning and rehearsal systems are discussed.

Requirements for an Urban Structure Digital Database to Support the Antiterrorism (AT) Planner

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A proof of concept prototype of AT Planner was developed in 1995. The prototype architecture is organized around assets, threats, and protective measures. The user describes the potential threats and the assets to be protected. AT Planner then provides doctrinally-sound (based on FM 5-114 and the Omaha Security Manual) protection options.

The next phase of this research is to develop and implement new capabilities for AT Planner and to develop the capability for AT Planner to interoperate with other tactical planning systems. Our general approach will be to 1) develop a stable foundation for AT Planner to share data and methods with other tactical systems, and 2) adapt accepted analytic and knowledge-based vulnerability assessment methods for use in this context.

In order to accomplish the interoperability with other tactical planning system, it is required that a comprehensive urban terrain digital database be developed and available. This presentation will describe the urban feature requirements for the AT Planner in order to establish the need for these attributes, as well as, to open dialogue on these requirements with organizations responsible for the development of the urban terrain digital databases.

<u>*Wednesday, 1330-1500*</u>
MCM/METOC Tactical Applications

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It has long been recognized the environment plays a critical role in Mine Warfare (MIW). Presently, there are various efforts underway to collect environmental data to support MIW. Each of these efforts has a goal of providing more accurate and complete information about a given environment to the MCM/MHC ship. Currently, the information derived from environmental data can not be used to improve the effectiveness of a minehunting operation. This paper will describe how the Fleet currently uses environmental data and a plan addressing how to optimally use the data.

Impact of the Littoral Environment on Minehunting Operations

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Approved abstract not available at printing.

Wednesday, 1515-1645
Environmental Effect on Mine Countermeasures

Dr. Peter Chu
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Phone:

Approved abstract not available at printing.

Forecasting River Stages World-Wide

Dr. William D. Martin
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Military operations often are presented with rivers as obstacles. Such obstacles may only need be crossed once at a specific point in time or continuously as a section of a Main Supply Route (MSR). Current technology and expertise provide the ability to obtain the necessary data and provide accurate forecasts as to future river stages for several days into the future. This is especially true for Special Operations/Operations Other than War (SO/OOTW). This paper lays out data needs and describes procedures developed by the U.S. Army Engineer Waterways Experiment Station (WES) necessary to support SO/OOTW world-wide. The procedures integrate coordinated use of ground observations, remotely sensed data, numerical modeling, global weather forecasting, and wide-net communications to provide Commanders with accurate and timely information on likely changes in river stages for the operational future (1-10 days). Statistical analyses can provide further insight into strategic time scale variations (1-12 months). The Sava River Forecasts in support of Operation Joint Endeavor are presented as a case study.

Thursday, 0830-1000
IPB Process Value Added via Computer-Aided Procedures: Methodology and Results

Mr. Jeffrey L. Williamson
USAE Waterways Experiment Station
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Vicksburg, MS 39180
Phone: (601) 634-3369

Intelligence Preparation of the Battlefield (IPB) functions at echelons brigade and below are typically time sensitive, time consuming procedures performed manually. Computer-aided procedures (e.g., ground vehicle mobility assessments) complimenting or replicating traditional manual approaches exist but are not readily available at brigade and below. Increased quality, consistency, objectivity, and completeness in products and analyses as well as time savings for the analyst potentially result from utilizing such computer-aided procedures.

Under sponsorship of the Office of the Deputy Chief of Staff for Intelligence, Headquarters, Department of the Army, the US Army Engineer Waterways Experiment Station, with over 40 years of experience in vehicle mobility research, conducted a study as part of the FY96 Army Study Program to identify mobility-related IPB functions and assess value added in automating them at echelons brigade and below. The study incorporated formal hypotheses, analytical rigor, and soldier involvement. Designed experiments with the Military Intelligence Officer Advanced Course and questionnaires disseminated to Army S2 staff and course participants were employed to assess value added. The study provides a prospective framework for evaluating the impact of decision support technologies and battlefield digitization on performance. The purpose of this paper is to present study methodology and findings.

Assessment of Mobility Performance within CCTT

Dr. Niki Deliman
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Realisitic mobility representation and movement behaviors are crucial issues for the Close Combat Tactical Trainer (CCTT). The mobility representations within CCTT Semi-Automated Forces (SAFOR) is based on relationships employed by the NATO Reference

Mobility Model (NRMM) modified to meet constraints such as data requirements and run-time. The NRMM is a detailed model which incorporates vehicle, terrain, and scenario parameters to determine vehicle speed in an area; it was identified by the Army Model and Simulation Office Standards Category MOVE as the recommended standard model for vehicle movement in the constructive environment. In NRMM, the input data for environmental features is utilized directly, resulting in an infinite number of possible data sets. The CCTT SAFOR mobility model clusters environmental feature input data into a manageable subset of categories based on ranges in values. Since correlation between constructive and virtual environments is crucial, a systematic analysis comparing the mobility performance of CCTT SAFOR to NRMM results is being conducted to evaluate the impact of clustering data into the currently used categories. Measures of performance (MOPs) include vehicle speed predictions, percentages of severely restricted areas, and speed controlling factors. Measures of effectiveness will be derived from MOPs. Both tracked and wheeled vehicle configurations will be assessed over a variety of regions. Sensitivity analysis and designed experiments will be used to evaluate differences in model results. The purpose of this presentation is to present the methodology employed and emerging results.

Thursday, 1330-1500
Littoral Meterological/Oceanographic (METOC) Tactics

Tom Little
Sea-based Weapons and Advanced Tactics School (SWATS)
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Fleet awareness of meteorology/oceanography factors in littoral regions is critical to gaining the tactical advantage against quiet diesel submarines. Undersea Warfare (USW) aircrews are taught METOC tactics at various Navy schoolhouses. Unfortunately, current wargame systems and Weapons Systems Trainers (WST) do not realistically simulate environmental factors in high priority operational areas (OPAREAS). Because of this, aircrews are unable to "train as they fight". Government and industry leaders need to be aware of critical environmental factors that impact military operations so that they can incorporate these environmental factors into future wargame systems and trainers.

In order to gain an appreciation of METOC Tactics that are executed during aircraft USW operations, a littoral Tactical Situation (TACSIT) will be presented. As discussed in the Office of Naval Intelligence (ONI) "Worldwide Submarine Challenge" publication, Iran intends to expand its regional influence. They have recently acquired two KILO diesel submarines and another one will follow. The Head of the Iranian Navy stated that "...Submarines will allow the consolidation of Iranian naval superiority in the entire Persian Gulf and the Strait of Hormuz."

METOC factors that will impact USW operations in the Gulf of Oman/Strait of Hormuz OPAREA include the sound velocity profile, bathymetry, bottom composition, reverberation, ambient noise, weather, upper-air refractive conditions, etc. The majority of these environmental factors vary from hour to hour, day to day, and season to season. These changes significantly impact acoustic and non-acoustic detection ranges and numbers of assets required to accomplish the mission. The impact of the environment on site-specific USW exercises and on-station aircraft tactics will be addressed.

WG 17 – Operational Contributions of Space Systems – Agenda
Chair: Lt Col Jerry Diaz, AFMC/DRA
Co-Chair: Lt Col Frank Swehosky, HQ AFOTEC/SA
Advisor: Gary B. Streets, SWC/AEW
Room: Diamond Hall – CR-6 and MCRC – CR-165

Room: Diamond Hall – CR-6

Tuesday, 1030-1200
Space Systems in JWARS
Lt Col John O. Yanaros, JWARS, OSD(PA&E)

Campaign Utility of Space Analysis – Part II
Dr. Robert W. Reid, Jr., The Aerospace Corporation

Tuesday, 1330-1500
COMPOSITE GROUP IV SESSION .... Ellis Hall

Room: MCRC – CR-165

Wednesday, 0830-1000
Hyper-Spectral Imagery (HIS) and the Warfighter – A Challenge for Operations Research
Timothy J. Eveleigh, Space Warfare Center

Incorporating Space Play into the Air Force Command Exercise System
Capt Robert Payne, Jr. and Lt Donald R. Bellew, Air Force Wargaming Institute (AFWI)

Wednesday, 1330-1500
Space and Missile Optimal Analysis (SAMOA)
Capt Jeff Grobman, Office of Aerospace Studies

RLV Pop-up Study
Capt Michael H. Platt, Office of Aerospace Studies

Wednesday, 1530-1700
Coverage Vulnerabilities and Military Worth of the4 Global Positioning System
Maj Dan Zalewski, AFSAA/SAA

Quick-Reaction Experiments in Warfare Modeling and Military Utility Analysis for Space Systems: Cause-and-Effect Links and Operational Impacts
Dr. C. Christopher Reed, The Aerospace Corporation

WG 17 – Operational Contributions of Space Systems – Agenda

Tuesday, 1030-1200
John O. Yanaros, Jr., Lt Col, USAF
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1745 Jefferson Davis Highway
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Space Systems in JWARS

The department of defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of

Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

This briefing will address JM&SRG requirements, User Group defined scenarios/partitions/use- cases, and associated MOPs/MOEs that will shape the development of JWARS. Potential legacy models and functionalities for reuse will be presented, derived through JWARS workshops and web site discussions. The presentation will conclude with a status update on the JWARS program. For Space contributions to JWARS, with respect to 65th MORSS WG interest, initial work for IOC (Block I) focuses on space support and enhancement missions within the scope of the development scenarios. Space control, application and attack will follow in the development of JWARS Block II and III (FOC).

Dr. Robert W. Reid, Jr., Senior Engineering Specialist
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Campaign Utility of Space Analysis - Part II

Abstract: In determining the need for future military space systems, one would like to proceed in an objective manner which relates space system performance to larger military objectives. The justification for a particular system is sought in the bottom-line value it provides to actual military operations.

Toward this end, an analysis process is described which links space system performance to military effectiveness at a campaign level of conflict. This process, which is described in **Campaign Utility of Space - Part I,** is a framework for combining campaign objectives, modeling and simulation tools, and representative scenarios into a unified analysis structure.

The principal elements of the framework include a campaign operational task flow, a campaign math model, a metric roll-up methodology, campaign scenarios, and a procedure for assessing performance sensitivities and determining system requirements. The campaign math model used in this description of the process is the Space Utility Math Model (SUMM) which was derived to complement the framework and to illustrate the methodology for a specific campaign scenario. The SUMM tool represents campaign force elements in aggregated fashion. The attrition of opposing force elements is the result of engagement interaction. This tool characterizes engagement effectiveness via a matrix structure which accounts for battle tempo, force access, and force efficiency. The SUMM tool is a planning aid which is intended to interface with larger campaign simulations working at the micro-shooter level. Both the framework process and the SUMM tool are applied to the sample scenario as a means of exposition.

Tuesday, 1330-1500
COMPOSITE GROUP IV SESSION

Wednesday, 0830-1000
Hyper-Spectral Imagery (HIS) and the Warfighter – A Challenge for Operations Research

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Approved abstract not available at printing.

Incorporating Space Play into the Air Force Command Exercise System - Approved abstract not available at printing.

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Wednesday, 1330-1500
Space and Missile Optimal Analysis (SAMOA)
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Approved abstract not available at printing.

RLV Pop-up Study

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Approved abstract not available at printing.

Wednesday, 1530-1700
Coverage Vulnerabilities and Military Worth of the4 Global Positioning System

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This study investigates the capability of the Global Positioning System (GPS) given differences in satellite availability, reliability, and replenishment rates. In Phase I, we combine results from satellite availability and satellite coverage models with weaponeering analysis to estimate impact on the warfighter. In Phase II, we expand our scope to incorporate combat simulations to provide a measure of the military worth of GPS. Our briefing will concentrate on methodology and lessons learned in Phase I and the plans for Phase II.

Quick-Reaction Experiments in Warfare Modeling and Military Utility Analysis for Space Systems: Cause-and-Effect Links and Operational Impacts

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Approved abstract not available at printing.

WG 18 - OPERATIONS RESEARCH AND INTELLIGENCE ANALYSIS - Agenda

Chair: Dr. Allan S. Rehm, MITRE Corporation
Cochair: Dr. John A. Battilega, Science Applications International Corporation
Advisor: Mr. Peter S. Shugart, TRAC, White Sands Missile Range
Room: Diamond Hall – CR-4 and C&SC – CR-226

Room: Diamond Hall – CR-4

Tuesday, 1030-1200
Information Warfare and Force Structures
Mr. Joseph J. Helman, Mr. David Dunham, TASC

Land Warfare Representations in the Joint Warfare System (JWARS)
LTC Terry W. Prosser, JWARS

Tuesday, 1330-1500
COMPOSITE GROUP IV SESSION .... Ellis Hall

Room: C&SC – CR-226

Wednesday, 0830-1000
The Other Side of the Mountain: Mujahideen Tactics in the Soviet-Afghan War
Mr. Lester W. Grau, Foreign Military Studies Office

Threat Emissive Sources On The Battlefield: Their Effects And Analytic Challenges They Present
Mr. Peter S. Shugart, TRAC White Sands, New Mexico

Wednesday, 1330-1500
Foreign Integrated Air Defense Systems Intelligence Analysis and Production
Mr. David M. Panson, NAIC/GTI

Sensor Platform Allocator Model and Analysis Tool (SPAM/AT)
Ms. Audree Newman, Air Force Studies and Analysis Agency; Mr. Roy Rice, Teledyne Brown Engineering; Mr. Kurt Willstatter, MRJ Technology Solutions

Wednesday, 1530-1700
Production Prediction Model
Mr. Graham T. Richardson, US Arms Control and Disarmament Agency

Effective Target Engagement (ETE): The New Method Of Attacking Targets In The Same Old Way.
Mr. Peter S. Shugart, TRAC White Sands, New Mexico

Thursday, 0830-1000
Hyper-Spectral Imagery (HIS) and the Warfighter - A Challenge for Operations Research
Mr. Timothy J. Eveleigh, Space Warfare Center

Counter Logistics Through Network Interdiction
LT Sean T. Moriarty, US Naval Postgraduate School

Thursday, 1330-1500
The Lockwood Analytical Method for Prediction (LAMP)
Dr. Jonathan S. Lockwood, DIA; Mr. John Coale, DIA

Modified "LAMP" Analysis of Computer-Related Information Warfare
Mr. John Coale, DIA

Implementing Information Warfare in the Weapon Targeting Process
CAPT Kenneth P. Haertling, Air Force Institute of Technology

Thursday, 1530-1700
IPB Process Value Added via Computer-Aided Procedures: Methodology and Results
Dr. Niki C. Deliman, Mr. E. Alex Baylot, Mr. Jeffrey L. Williamson, USAE Waterways Experiment Station; Ms. Laura Bunch, MEVATEC

Expeditionary Warfare Threat Environment Projections
Mr. Benjamin Wong, Marine Corps Intelligence Activity

Alternate
Foreign Armored Systems Operations Research
Major John R. Henderson

WG 18 - OPERATIONS RESEARCH AND INTELLIGENCE ANALYSIS - Abstracts

Tuesday, 1030-1200
Information Warfare and Force Structures

Mr. Joseph J. Helman and Mr. David H. Dunham
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Phone: (703) 558-7400

Traditional methods of warfare are being supplemented by technology-based warfare, including what has become known as Information Warfare (IW). An attack upon an adversary's vital national resources is no longer limited to the overt, physical destruction of those resources. Substantial and potentially devastating damage can be inflicted without crossing the threshold of violence, or even physically crossing international borders.

Some proponents posit that IW could reduce the likelihood of armed conflict since adversaries could be deterred by an IW threat to their vital interests. Should deterrence fail and armed conflict occur, IW could also contribute to achieving a rapid, decisive outcome, thereby lowering the human and materiel costs of war.

In an era of declining budget resources, some would argue that a robust IW capability could facilitate reductions in force structures in exchange for lower cost, less violent IW capabilities. This argument assumes that the threat of IW is as persuasive, and can achieve similar political and military results as other types of weapons; a proposition that has yet to be systematically examined.

This study addresses this proposition via the following research questions: Can IW contribute to U.S. deterrent posture? What lessons can we learn from the evolution of nuclear deterrence when compared to IW?

Land Warfare Representations in the Joint Warfare System (JWARS)

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The department of defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

Land warfare is an area of primary focus in the JWARS project. Areas of interest include movement, doctrine and tactics, including maneuver warfare, engagements and attrition, and the impact of information operations on battle outcomes. This presentation will discuss the land warfare representations in the JWARS testbed and the lessons learned in developing the testbed. A portion of the testbed discussion will deal with representations of perception vs ground truth. The presentation will also discuss future directions for land warfare functionality in production versions of JWARS.

Tuesday, 1330-1500
COMPOSITE GROUP IV SESSION

Wednesday, 0830-1000
The Other Side of the Mountain: Mujahideen Tactics in the Soviet-Afghan War

Mr. Lester W. Grau, Analyst
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When forecasting future war, emerging technologies play a dominant role as military planners integrate geo-strategic realities, national interests, developing alliances and existing armed forces with the uncertainties of the future. Such future technologies have the most application in fighting a conventional, maneuver war. The leverage technology offers depends on the circumstances shaping combat such as the theater, the opponent and the objective. Technology offers little decisive advantage in guerrilla warfare. An effective way for a technologically less-advanced country or faction to fight a technologically-advanced country or coalition is through guerrilla war. Guerrilla war, a test of national will and the ability to endure, negates many of the advantages of technology.

Mr. Grau's book, The Bear Went Over the Mountain: Soviet Combat Tactics in Afghanistan examined Soviet small unit tactics from the Soviet perspective. He and Mr. Ali Jalali have since conducted over fifty interviews of Mujahideen commanders to capture their lessons and the evolution in their tactics. The results are included in their soon-to-be-published book, *The Other Side of the Mountain: Mujahideen Tactics in the Soviet-Afghan War*. The book contains case studies on ambush, raids, urban combat, blocking enemy lines of communication, siege warfare, defense, fighting a heliborne insertion, attacking a strong point and mine warfare. The scale of combat varies from ten-man cells to operations of a thousand or more guerrillas.

Mr. Grau argues that modern, high-technology forces are still in peril when committed to fight guerrillas. Modeling and developing norms for such combat is difficult, but these case studies provide a base line.

Threat Emissive Sources On The Battlefield: Their Effects And Analytic Challenges They Present

Mr. Peter S. Shugart
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This presentation will present evidence of emissive sources on the battlefield and their effects on sensors. The analytic programs necessary to address the Combined Arms combat consequences of these sources, and the current status of those programs will be presented.

Wednesday, 1330-1500
Foreign Integrated Air Defense Systems Intelligence Analysis and Production

Mr. David M. Panson, Integrated Air Defense Systems Analyst
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This presentation will discuss the new DoD IADS support Program (DODISP) and how a new team has been formed to pool resources from several organizations to conduct IADS intelligence analysis and production. This approach eliminates redundancy and allows for a single point of contact for foreign 'big picture' IADS intelligence, namely NAIC/GTI. To further help stretch resource NAIC/GTI is pioneering a new vital environment to facilitate intelligence production electronically. IADS products are becoming paperless with a push towards total visualization techniques to illustrate the IADS, suing point and click techniques to bring up details. Visualization will go hand in hand with modeling and simulation efforts beginning to take shape in GTI.

Modeling and simulation will play a key role in the analysis of foreign IADS. NAIC hopes to leverage off existing simulation tools with wide community acceptance as well as developing any new tools that are required. Simulations may include integrating existing proven models into the simulation. Eventually NAIC hopes to have a completely interactive IADS simulation/visualization. The user will be able to play as an interactive participant at any point in the IADS. This could be from a pilot's point of view inside the cockpit as he flies into an enemy IADS, to a radar operator on the ground watching his radar scope.

Modeling and simulation techniques will have to be flexible enough so that any type of IADS can be modeled quickly since it will be unrealistic to have an IADS model on the shelf for every country. As new IADS technologies evolve the simulation will also have to be able to adapt in order to provide accurate representations. We also hope to also use our IADS models as customer products that can

be combined and used with the customers own models and simulation where threat IADS modeling is required.

Sensor Platform Allocator Model and Analysis Tool (SPAM/AT)

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SPAM/AT is a Mixed Integer Program (MIP) managed by the air Force Studies and Analysis Agency (AFSAA) and developed by Teledyne Brown Engineering (TBE). It determines the optimal mix of intelligence, reconnaissance and surveillance (ISR) systems. The optimum is classified by one of several objective functions, including target coverage, acquisition, and operating costs, and value of information collected. The allocation of sensor-platform resources are calculated for various target categories (includes IMINT and SIGINT), in multiple distance bands, during multiple time periods. Constraints include resource conservation from one time period to the next, platform attrition, number of additional sensors and platforms that can be added to an existing inventory, and intelligence collection thresholds.

SPAM/AT has been applied by AFSAA to identify and evaluate force mix options for the Defense Airborne Reconnaissance Office (DARO). The process of deriving these force options with SPAM/AT provided DARO with insights regarding deficiencies in meeting target coverage requirements. DARO used these insights to develop recommendations for the Quadrennial Defense Review (QDR).

SPAM/AT may be used as a stand-alone analysis tool or in combination with Air Force's Combat forces Assessment Model (CFAM) to quantify the military worth of ISR systems to weapons employment. Output from SPAM/AT, such as percent target coverage and probabilities of battle damage assessment, may be input into CFAM to show how a particular ISR force mix impact weapons employment and targets filled.

Wednesday, 1530-1700
Production Prediction Model

Mr. Graham T. Richardson
US Arms Control and Disarmament Agency
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Phone: (202) 736-4457

A production prediction model (PPM) was developed to model the need for and flow of foreign (Soviet-style) military production. The model successfully emulated unpublicized data on military manufacturing activities in denied areas. This provided a perspective on product flow that was not possible based on detailed intelligence data. Detailed, technical understanding of the manufacturing process and procurement philosophy was used to tailor a simple model that required a limited number of gross parameters - population data of the military item and three technical factors relating to product quality and longevity. Analysis based on PPM supported and supplemented more traditional intelligence gathering processes in two ways:

- it verified the reasonableness of the data compiled through the traditional process, and
- it provided a testing ground to examine excursions and project into the future.

Effective Target Engagement (ETE): The New Method Of Attacking Targets In The Same Old Way.

Mr. Peter S. Shugart
USA TRAC
ATTN:ATRC-WJB (Mr. Pete Shugart)

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Recently, the Russian journal Military Thought has had a series of articles discussing ETE. This presentation will summarize the current Russian thinking, and will demonstrate how this new method is evolutionary rather than revolutionary.

Thursday, 0830-1000
Hyper-Spectral Imagery (HIS) and the Warfighter - A Challenge for Operations Research

Mr. Timothy J. Eveleigh, Applications Engineer
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Approved abstract not available at printing.

Counter Logistics Through Network Interdiction

LT Sean T. Moriarty, USN, US Naval Postgraduate School Student
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Phone: (408) 656-2786

The center of gravity in any campaign can be justifiably argued to be the enemy's logistic tail. History has shown that there can be no long lasting tactical progress without proper logistics. The nature of logistics lends itself to being represented by network graphs. It is the exploitation of these networks that this paper deals with.

The paper is a work in progress Masters Thesis which began 6 JAN 97. The goal is to develop a tool for planners to determine where best to undermine enemy logistics by exploiting the known logistics networks. The purpose is not to develop new algorithms for analyzing networks but to use a library of existing solvers combined with a given data base of enemy networks to determine an enemy's vulnerabilities and to marry the two with a geographic interface. Once all three pieces are brought together, the user will be able determine not only which node or arc to eliminate, but by how much the elimination of such arcs and nodes will affect the logistics pipeline for a given commodity. As well as finding the optimal arcs and nodes, the program is interactive so that "what if" analysis can be employed by the click of a "mouse" on the node(s) or arc(s) in question. The reverse action of determining the optimal allocation of resources to reestablish a damaged network is also addressed. This can be applied to a wide variety of full spectrum operations/ MOOTW applications such as peacemaking and enforcement..

The key to the entire project is the fact that the program is written in Java, a new programming language by Sun Microsystems, which can run on a wide variety of hardware platforms and can be loaded dynamically via a network . It is a robust, completely object-oriented language that allows programs to work on multiple tasks simultaneously and automatically recycles memory. A Java program can be compiled and stored on a "type A" machine and via an existing computer network can be imported and executed on a "type B" machine. The benefits of this approach include reduced development costs and reduced software support costs.

Thursday, 1330-1500
The Lockwood Analytical Method for Prediction (LAMP)

Dr. Jonathan S. Lockwood
Presented by: John Coale, GS-14, Senior Intelligence Analyst
Defense Intelligence Agency
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The Lockwood Analytical Method for Prediction, or LAMP, has become a standard predictive analysis tool for the Intelligence Community. It introduces an innovative framework for developing intelligence estimates and indications and warning. LAMP's broad appeal to intelligence analysts rests in the fact that it provides a logical method for analyzing the future's many potential paths and the free will of many actors. It has become the methodology of choice for numerous students performing thesis research in military and intelligence academia (Ft. Huachuca and the Joint Military Intelligence College). LAMP software is being developed to increase this methodology's applicability and usefulness.

Modified "LAMP" Analysis of Computer-Related Information Warfare

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The growing use and dependency on computer systems in the Department of Defense has created new security vulnerabilities. Using the Lockwood Analytical Method for Prediction (LAMP), specific Russian scenarios and alternate futures involving foreign offensive Information Warfare against the U.S. military were analyzed. Conclusions from this analysis provide recommendations for improving Intelligence Community support to the National Military Strategy.

Implementing Information Warfare in the Weapon Targeting Process

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Approved abstract not available at printing.

Thursday, 1630-1800

IPB Process Value Added via Computer-Aided Procedures: Methodology and Results

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Intelligence Preparation of the Battlefield (IPB) functions at echelons brigade and below are typically time sensitive, time consuming procedures performed manually. Computer-aided procedures (e.g., ground vehicle mobility assessments) complementing or replicating traditional manual approaches exist but are not readily available at brigade and below. Increased quality, consistency, objectivity, and completeness in products and analyses as well as time savings for the analyst potentially results from utilizing such computer-aided procedures.

Under sponsorship of the Office of the Deputy Chief of Staff for Intelligence, Headquarters, Department of the Army, the US army Engineer Waterways Experimental Station, with over 40 years of experience in vehicle mobility research, conducted a study as part of the FY96 Army Study Program to identify mobility-related IPB functions and assess value added in automating them at echelons brigade and below. The study incorporated formal hypotheses, analytical rigor, and soldier involvement. Designed experiments with the Military Intelligence Officer Advanced Course and questionnaires disseminated to Army S2 staff and course participants for evaluating the impact of decision support technologies and battlefield digitization on performance., The purpose of the paper is to present the study methodology and findings.

Expeditionary Warfare Threat Environment Projections

Mr. Benjamin Wong, GS-12, S&T Intelligence Specialist; Ms. Judy Hance
Marine Corps Intelligence Activity
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Phone: (703) 784-6103

This study will be a Marine Corps-specific, DIA-approved intelligence reference document that provides a baseline for use in

modeling, simulation, planning, and analytical activities in support of weapons acquisition development. The threats to be addressed will include those likely to be found in an expeditionary environment with focus on countries of Marine Corps interest as expressed in the Marine Corps Mid-Range Threat Estimate. Timeline for the initial threat projection will be 1997 through 2010.

This study will address the Marine Corps mission, mission area, or special interest area for which the operational environment is being described. Definitions will be sufficiently detailed so as to enable the extraction of those Marine tasks/capabilities that are most sensitive to threat capabilities.

Consequently, the current and future operational, physical, and technological environment in which the Marine Corps forces, weapons, systems will have to function will be discussed. Developments and trends that can be expected to affect mission capabilities would be projected out to 2010. Areas covered include enemy doctrine, strategy, and tactics that will affect Marine Corps operational planning and capability. Consideration will be given to the interplay of technology and operational factors on adversary doctrine, strategy, tactics, intentions, weapons systems capabilities, force, structure, force employment, training/readiness, and overall force capabilities.

Besides regional issues, current and future threat systems, their technical performance, characteristics, and capabilities will be compiled along threat hardware functional lines, providing the global technology "menu" from which assessments of applicable systems/technologies to specific foreign military forces can be made. The system specific threat to the mission capabilities of the Marine Corps will be assessed.

Lastly, the study shall focus on threat systems and technologies which would affect the lethality of Marine Crops firepower against threat targets.

Alternate
Foreign Armored Systems Operations Research

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Research into foreign combat systems has, until now, been confined to a systems effectiveness in distinct areas. This project aims to answer questions concerning a system's combat effectiveness in an operational environment. Information gained from previous projects, such as the system's mobility, protection and firepower, is used as inputs to the CASTFOREM model at TRADOC Analysis Center, White Sands Missile Range, NM. The CASTFOREM analysis takes the form of a conventional cost and Operational Effectiveness Assessment (COEA), except that the blue side remains unaltered; there is an accepted base case, and the new red system is substituted in the second run, which allows the analyst to calculate the change in operational effectiveness.

This project is in its infancy, but preliminary results indicate that the accuracy of results for all CASTFOREM studies will benefit from the work being conducted on the red forces. Changes have already been made in the way in which "red" fights its tanks, the example which has been chosen for this first year's work.

It is hoped that the intelligence community will be able to use tools such as CASTFOREM in the future to address questions about other systems, both from the point of view of their combat effectiveness and the tactical doctrine used in their employment.

WG 19 - MEASURES OF EFFECTIVENESS - Agenda
Chair: Robert J. Meyer, NAWC-WPNS
Cochair: Lt Col Mark Reid, AFOTEC
Cochair: Wyoming B. Paris, AMSAA
Advisor: John M. Green, Lockheed Martin
Room: C&SC – CR-216, SNCOA – CR-2 and Little Hall – CR-1

Room: C&SC – CR-216

Tuesday, 1030-1200
JWARS MOEs and MOPs: Analytical Building Blocks
LCDR Jeffrey R. Cares, USN, JWARS Office, OSD(PA&E)

Mine Warfare (MIW) Metrics
Curtis A. McVey, Jr, Head, Mission Analysis Branch, NSWC

Comparative Assessment of THUNDER and TACWAR Model Results
Robert Larkin, Senior Analyst, System Simulation Solutions, Inc. (S3I)

Tuesday, 1330-1500
Optimizing Verification & Validation for Minimal Risk
Dennis Laack, Computer Sciences Corporation

Evaluating Concepts for Futures Planning
Maj Lynne E. Baldrighi, Strategic Planner, Hq USAF/XPXC

A Value Function Approach to Information Warfare MOEs: A Preliminary Study
Capt Michael P. Doyle, Department of Operational Sciences, AFIT/ENS

Wednesday, 0830-1000
Measuring the Robustness of Electronic Countermeasure Techniques in Terms of Aircraft Survivability
Dr. Frank B. Gray, Office of the Chief Scientist, AFOTEC

Putting EW in its Place: Measuring ECM in the Context of Survivability
Robert J. Meyer, Operations Research Analyst, NAWC-WPNS

Wednesday, 1330-1500
The Valuated State Space Approach
Lawrence J. Fogel, Ph.D., President, Natural Selection, Inc.

Using the Analytic Hierarchy Process in a Cost and Options Analysis.
Don Olynick, Senior Systems Engineer, ANSER Corporation

Wednesday, 1530-1700
COMPOSITE GROUP V SESSION .... Ellis Hall

Room: SNCOA – CR-2

Thursday, 0830-1000
Joint Anti-Armor Special Study Item Level Performance Analysis
Ronald Thompson, U.S. Army Materiel Systems Analysis Activity (AMSAA)

An Assessment of the Parametric Endo/Exoatmospheric Lethality Simulation (PEELS) Hit to Kill Prediction Capability Against Theater Ballistic Missiles
Johnny L. Graham, GS-13, Operations Research Analyst, AMSAA

An Approach to Constructing a Bayesian Probability Distribution for P_K Based on Simulation Modeling and Model Performance Parameter Test Data
Michael B. Dewitz, GS -13, Operations Research Analyst, AMSAA

Room: Little Hall – CR-1

Thursday, 1330-1500
Battle Synchronization Assessment Criteria
Douglas Macpherson, US Army Research Institute (ARI)

Combat MOEs in Relationship to Historical Evidence.
Walter J. Bauman, GS-13, Operations Research Analyst, USA Concepts Analysis Agency

WG 19 - MEASURES OF EFFECTIVENESS - Abstracts

Tuesday, 1030-1200
JWARS MOEs and MOPs: Analytical Building Blocks

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The Department of Defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

Many older generation models were developed from a list of functional requirements which included MOEs and MOPs only as afterthought. Many others developed MOEs and MOPs only after the model functions and operations were built. Conversely, the JWARS project is taking an approach designed to build an *analytical tool*. Through a collaboration with the broad range of analytical organizations represented in the JWARS Usersí Group, the JWARS development team has established Essential Elements of Analysis (EEAs) and corresponding MOEs and MOPs as the centerpiece of the requirements definition and, therefore, integral and vital to model development. This presentation will discuss the method by which the EEAs, MOEs and MOPs were developed as well as the validity and applications of the MOEs and MOPs themselves.

Mine Warfare (MIW) Metrics

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This paper describes the Navy Mine Warfare (MIW) community's efforts in providing management officials, program teams, and supporting Navy laboratories and contractors specific guidelines concerning the adoption of the performance measures for associated acquisition programs. A standardized set of MIW metrics consisting of system-level measures of performance (MOPs) and mission-level measures of effectiveness (MOEs) has been developed to promote a common language to facilitate information exchange and to view the results of MIW interactions from a common perspective. Representative Mine Counter-Measures missions are used to provide examples of the specific mathematical relationships between the MOPs and MOEs.

Comparative Assessment of THUNDER and TACWAR Model Results

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Approved abstract not available at printing.

Tuesday, 1330-1500
Optimizing Verification & Validation for Minimal Risk

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A major challenge facing the acquisition community, when using models and simulations (M&S) to support RDT&E activities, is determining what type and how much V&V are necessary and sufficient to justify accreditation and use of a particular model or set of M&S. Most model users tend to perform as much V&V work as the budget will permit and then hope that the volume of data produced will be sufficient to convince the accreditation authority, and possible program detractors, that the V&V data justifies confidence in the accuracy of model outputs. A suggested approach to determining the minimum essential V&V activities uses an analytical technique that is similar to the one described in MIL-STD-882C, the System Safety Standard. This approach starts with the identification of potential risks and benefits associated with the intended acquisition decision, assesses and subjectively quantifies these risks and benefits, and then develops credibility requirements for the selected M&S suite. These credibility requirements are used, in turn, to identify a minimum essential set of V&V tasks.

There are two prerequisites for using this approach. The first is a clear understanding of the acquisition problem or decision(s) and the potential risks and/or benefits that might accrue from the possible decision(s). The second prerequisite is that there be an accepted menu of V&V tasks which is normally used as a starting point when planning any V&V effort for applications similar to the one that is underway. The benefits of this approach are twofold. The first is a definitive set of V&V requirements that are logically derived and traceable to the acquisition objectives and parameters. The second is the availability of a clear set of criteria at each step in the process. These criteria are open to review and discussion so that there is an agreed upon basis for selecting and planning the V&V activities.

Evaluating Concepts for Futures Planning

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Approved abstract not available at printing.

A Value Function Approach to Information Warfare MOEs: A Preliminary Study

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Approved abstract not available at printing.

Wednesday, 0830-1000
Measuring the Robustness of Electronic Countermeasure Techniques in Terms of Aircraft Survivability

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Quantitative measures (using probability of kill) are developed for the relative robustness of jamming techniques to manufacturing variations and field maintenance practices. A countermeasure technique is called *robust* if the techniqueís effectiveness is relatively insensitive to normal serial number-to-serial number and day-to-day variability. Parameters that could vary in these situations include

activation thresholds, time delays, or alignments. Effects of variations are measured with computer simulations that ìshootî different threat serial numbers against targets employing specified countermeasure techniques. Classic experimental design methods and robust parameter design techniques are adapted to separate the variation in probability of kill due to different serial numbers from the variation due to other sources. Two situations are considered--comparing the relative robustness of several different countermeasure techniques and assessing the absolute robustness of one technique. The first situation uses an adaptation of some new techniques for modeling process variation in robust design applications. These techniques are shown to offer advantages over classical Taguchi methods. The second, which augments operational flight testing with modeling and simulation, uses a traditional slit plot experimental design and leads to a measure of *percent robust* for a given countermeasure technique.

Putting EW in its Place: Measuring ECM in the Context of Survivability

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One of the raging debates within DOD over the last ten (or more) years is how to (best) measure the "military worth" or contribution to warfighting ability of Electronic Warfare (EW) in general and Electronic Counter Measures (ECM) in particular. Previous work suggested that rather than using the fuzzy concept of "military worth," EW/ECM utility may be best be measured in more concrete terms familiar or at least understandable to the operational units which are expected to employ that EW/ECM. One of the ways previously suggested to portray ECM utility was to couch it in terms of single-ship survival. and how one could trade-off ECM benefits with those provided by stealth, tactics, maneuverability, situational awareness, vulnerability reduction, etc., in the context of platform survivability.

The replacement of the term "military worth" with more concrete measures is not arbitrarily limited to engagement-level issues such as platform survivability, but has logical extensions to all levels of combat. This presentation explores such concrete measures not only at the engagement level, but upwards through "mission level" to "force level" and beyond, showing that at each level such measures exist but are best understood in the very unique and non-linear (subjective) contexts associated with those levels. Further, this presentation argues that any pseudo-mathematical cascading of these measures into some overall notion of "military worth" misses the mark badly, and that only contextual assimilation of these measures allows their full embodiment in both requirements development and subsequent test and evaluation.

Wednesday, 1330-1500
The Valuated State Space Approach

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Effective management begins with a clear understanding of what must be achieved by when. But what if that outcome is not realized? Surely some value is found in lesser degrees of achievement. In other words, to be meaningful, we must identify the relative worth of each of the significantly different futures, all the way from utopia to catastrophe, for only then can we measure the overall worth of any given situation. Unfortunately, it is difficult to envision these significantly different futures, no less their relative worth. The Valuated State Space Approach provides a convenient way to overcome this difficulty. It yields importance weighted preferentially independent parameters that are measured in terms of the value of the significantly different degrees of achievement.

These measures are combined into an overall worth, taking their interdependency (degree of criticality) into account. Measures of effectiveness (MOEs) alone do not tell the whole story. Alternative "what ifs" can then be scored in terms of the corresponding futures. The best is selected and there is a list of the remaining deficiencies, by priority. The worth of partially resolving any of these remaining problems can be computed. But organizations affect one another. Our best move may not be best if it significantly injures an ally and/or greatly benefits a foe. The Valuated State Space Approach can be used to express the presumed purposes of the other players then find their best moves and ours in the light of the mutual attitudes and the state of the game.

Using the Analytic Hierarchy Process in a Cost and Options Analysis.

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This presentation discusses how the Analytic Hierarchy Process (AHP) was used in a Cost and Options Analysis to provide a military client with the information needed to select the best alternative to improve a major Air Force weapon system. Five different alternatives were compared to the current system in order to evaluate the possibilities. This briefing will primarily explain the methodology, discuss the Measures of Effectiveness (MOEs) and Measures of Performance (MOPs) evaluated, and present sanitized results (to protect contractor and program identities) of the analysis in terms of the cost-effectiveness ratios.

Initially, Functional Objectives (FOs), MOEs and MOPs were developed in line with the Air Force Modernization Planning process. The MOEs became the first level of criteria under the goal in an AHP structure, followed by the MOPs as sub-criteria and finally, the proposed alternatives at the bottom level of the hierarchy. Then, operator and technical analyst inputs were collected to derive the weights of all criteria. Next, performance data was collected and synthesized to compute the ratio scales for all proposed alternatives. Prior to the input of data, utility functions were developed to ensure all performance data across all criteria were in the same units. A separate structure to analyze the effectiveness, cost and technical risk of each alternative was designed. Finally, risk adjusted cost-effectiveness ratios for each alternative in a variety of scenarios were computed.

Wednesday, 1530-1700
COMPOSITE GROUP V SESSION

Thursday, 0830-1000
Joint Anti-Armor Special Study Item Level Performance Analysis

Ronald Thompson (and Lee Blankenbiller)
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A Joint Staff Special Study Team was formed to look at anti-armor munitions across the services and to provide a recommendation for the optimum mix in the post-2005 timeframe. In support of that effort AMSAA conducted an Item Level Performance Analysis to ascertain the effectiveness of 29 joint service munitions (Armor, Artillery, Fixed and Rotary Wing Aviation, and Infantry) against a comprehensive set of armored targets. Integration, analysis of results and findings (which built on the AMSAA Near (2005) and Far (2015) Term Anti Armor Resource Requirements (A2R2) Item Level Performance Analyses) were also provided. The primary measure of effectiveness was probability of mobility or firepower kill, per munition fired, as a function of range. For direct fire systems, accuracy from a stationary firing platform to a stationary target was used as representative. Surface indirect fire system and aircraft sensor fuzed weapon effectiveness was based on a volley of twelve submunitions vs. companies of thirteen moving tanks, thirteen moving BMPs, and a battery of 6 stationary howitzers. The number of kills in the array divided by the twelve munitions fired is the munition probability of kill vs. that target. That probability is then used in the comparison of direct and indirect fire systems.

An Assessment of the Parametric Endo/Exoatmospheric Lethality Simulation (PEELS) Hit to Kill Prediction Capability Against Theater Ballistic Missiles

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As part of the PEELS accreditation process (for use in the Theater High Altitude Area Defense (THAAD) milestone II phase), AMSAA and the PEELS accreditation working group conducted analysis of the PEELS database. This analysis focused primarily on comparisons of PEELS predictions, test results, and other simulation predictions. These comparative analyses consisted of four phases: 1) comparisons of PEELS predictions with sled test results, 2) comparisons of PEELS predictions with hydrocode predictions, 3) a comparison of PEELS prediction with a flight test, and 4) a comparison analysis of closing velocity percent occurrence for THAAD/threat intercepts with the closing velocity range for the PEELS database.

Since the measurement of engagement parameters for hit to kill sled test (and flight tests) is not accomplished with 100 percent certainty (there exists a degree of inherent uncertainty), comparing simulation predictions with results of sled tests requires consideration of these uncertainties. These uncertainties are attributable to the precision of the measurement instrumentation (instrumentation tolerances). The resulting measurement uncertainties can significantly affect results of simulations when trying to duplicate results from sled tests. Thus a PEELS sensitivity analysis was conducted to examine the effects of measurement uncertainties on PEELS prediction results. This paper describes the measures of effectiveness and methodologies used to perform all the above analyses and the results of these analyses (when measurement uncertainties are considered and when the measurement uncertainties are disregarded).

An Approach to Constructing a Bayesian Probability Distribution for P_K Based on Simulation Modeling and Model Performance Parameter Test Data

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Throughout the Army missile system acquisition process, estimates of true performance are compared to required performance (expressed by probability of kill (P_K)) as a means of determining whether a program should continue. Because true system performance is unknown, equally important as the estimate of true performance is a measure of assurance that the true performance exceeds the requirement. When the data used to develop the estimates of system performance come from system level testing of actual hardware, that assurance is often expressed in terms of confidence bounds using classical statistical analysis techniques. Funding available for testing Army missile systems is decreasing. Many programs are conducting more component and subsystem testing to quantify the performance parameters that define overall system performance and then executing complex simulations to relate these performance parameters to P_K. This presents the challenge of determining a suitable, quantifiable measure of assurance that true system performance exceeds the requirement when data come from both simulations and a wide variety of test sources.

AMSAA has developed methodology based on Bayesian analysis that quantifies the probability of belief associated with output from a simulation. The approach is to quantify the distribution of uncertainty in the input parameters to the simulation based on available test data. This uncertainty is used to generate a distribution of belief regarding the output of the simulation. The generated belief distribution gives the Bayesian probability that a specified level of performance has been achieved. This paper describes the methodology developed by AMSAA and discusses an example that demonstrates its applicability.

<u>*Thursday, 1330-1500*</u>
Battle Synchronization Assessment Criteria

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The Army's success on the battlefield depends on its ability to synchronize its Battlefield Operating Systems (BOSs) so that their effects summate and produce maximum relative combat power at decisive points. Recent ARI research demonstrated that it is possible to define specific types of synchronization objectively, identify types of synchronization in plans, and count occurrences of them in battles from Janus' simulation databases. This presentation describes the development of assessment criteria for the process and products of synchronization and reports how they apply to a defensive battle. The assessment criteria were developed from Army doctrine and from published weapons' effects. Synchronization was defined as the relationship among specific pairs and triplets of BOSs. For each of these, objective criteria were identified as indicators of when synchronization does and does not occur. Some of these criteria include: (1) number of obstructions completed at the planned time, (2) obstructions fired on by direct fire or by artillery; and (3) suppression of OPFOR during his attack. The assessment criteria were applied successfully to data obtained from the Tactical Commanders Development Course, Ft. Leavenworth using the Janus battle simulation environment. This application of the criteria suggested ways in which synchronization could have been improved. The criteria potentially have broad applicability because they are: (1) compatible with synchronization doctrine, (2) comprehensible and believable, (3) diagnostic of synchronization training, (4) planning and execution problems, and (5) computable and available for use in after action reviews. Discussions of the assessment criteria and their application will be encouraged as part of this presentation.

Combat MOEs in Relationship to Historical Evidence.

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The Ardennes Campaign Simulation Data Base (ACSDB), derived from historical archives, records daily combat status for units engaged in the 1944-45 Ardennes Campaign of WW II. The ACSDB is used to investigate empirical relationships, in the Ardennes campaign, between fractional exchange ratio (FER), force ratio, and FEBA movement. Historical data are used to compute historical FER,

and force ratio, for the Ardennes theater battle, and for the Ardennes Bulge battle, in eight 4-day time periods, based on five different system mixes, and two different loss criteria. Correlative empirical relationships, using trendlines, are then sought between FER and force ratio, and between FER and FEBA movement. Results include: (1) FER vs. Force Ratio. System FER and its associated force ratio are strongly related by an exponential-form relationship when FER is based on losses in at least (combined) tanks, anti-tank (AT) weapons, and artillery systems. Personnel FER and force ratio also have a strong exponential-form relationship, if FER is based on only combat losses (KIA, WIA, CMIA). These exponential-form relationships may sufficiently characterize actual combat to be useful as a validation criterion for simulated combat in theater models, and (2) FER vs FEBA Movement. System FER may be an indicator of approximate FEBA progress of engaged theater forces. The strongest empirical relationships compute FER using at least (combined) tanks, AT weapons, and artillery, with a damage criterion based on only destroyed and abandoned systems. Personnel FER based on combat casualties appears to be nearly as useful an indicator of FEBA progress as system FER.

WG 20 - TEST and EVALUATION - Final Agenda
Chair: Wink Yelverton, *SENTEL* Corporation
Advisor: Dr. Marion Williams, FS, AFOTEC/CN
Co-chair(s): Blair Budai, Edwards AFB
Gene Dutoit, Army Dismounted Battlespace Lab
Dr. Ernie Montagne, BDM
LT Cynthia Womble, COMOPTEVFOR
Michelle Kirstein, HQ AFOTEC
Room: MCRC – CR-166

Room: MCRC – CR-166

Tuesday, June 10, 1030-1200
Human Mounted Instrumentation System
Bruce P. Hunn, Air Force Flight Test Center

****Assessment of the Air Combat Environment Test and Evaluation Facility (ACETEF) To Support Operational Test and Evaluation***
John A. Bentrup, Center for Naval Analyses; Don Greaser, PRC, Incorporated; CDR Richard L. Bainbridge, Operational Test and Evaluation Force (OPTEVFOR)

Instrumentation Systems and Applicationsfor Electro-Optic (EO) Missile Warning Systems (MWS) Development and Testing
Dr. Charles Pender, Pender Technology; Patrick D. Quinn, SENTEL Corporation; Fred Sherrell, Sverdrup Technology

Tuesday, June 10, 1330-1500
Sensor Fuzed Weapon P^{3}I Optimization Tests
David M. Smith, KBM/TEAS

Joint Stand-Off Weapon (BLU-97) Live Fire Test and Evaluation
Robert L. Stovall and Carson W. Sasser, 46 OG/OGML (CHICKEN LITTLE)

Application of Controlled Test Events to Interpretation of Real-World LIVE FIRE Events
Elizabeth T. Thorn, Sverdrup (TEAS); Norman D. Fleming,

Wednesday, June 11, 0830-1000
****Risk in Weapon System Acquisition: An Approach to the Economics of Test and Evaluation***
Russell Lenz, 412TW/TS and Lee Gardner, 412 TW/TSDI

****Using Risk Assessments to Determine Appropriate Operational Testing for Software Intensive Systems***
LCDR Dale Spaulding, LT Cynthia Womble, and LCDR Bill Campbell, COMOPTEVFOR

Test Officer's Guide for Designing Valid Tests and Experiments
Rick Kass, U.S. Army Test and Experimentation Command (TEXCOM)

Wednesday, June 11, 1330-1500
Identifying the Imapct of Technical Issues on the Operational Performance of Weapon Systems
William J. Hughes, Evaluation Analysis Center, OTEC

****Non-traditional Operational Test and Evaluation to Support Non-traditional Acquisition***
2Lt Alan Camp and Ms. Janelle Loper, Joint Interoperability Test Command; Mr. Dennis Ballard and Dr. Ernest Montagne, BDM International

****Tactical Ballistic Missile Simulation in Support of Operational Testing of 3D Radar***
Captain Raphael Brown, Marine Corps Operational Test and Evaluation Activity (MCOTEA); Mr. Philip C. Minor, SRI International; Mr. Ernest Rockwood, Sensis

Wednesday, 1530-1700
COMPOSITE GROUP V SESSION...Ellis Hall

Thursday, June 12, 0830-1000

Simulation in Support of Developmental and Operational Testing for the Predator SRAW
Matthew M. Aylward, Gary R. Brisbois, and Sara F. McCaffery, The MITRE Corporation

Modeling and Simulation in Navigation System Test and Evaluation
Major Eileen A. Bjorkman, 746th Test Squadron

Captive Flight Test Planning and Playback System
Kirk L. Weeks, TASC

Thursday, June 12, 1330-1500

Electronic Combat Data Exchange
Mr. John Crane and Mr. Thomas H. Plank, Sverdrup Technology, Inc

Visualization of Field-Collected Data
Walter G. Butler, US Army TRADOC Analysis Center

McKenna Warfighter Evaluation
John D'Errico and Dr. Eugene Dutoit; Dismounted Battlespace Battle Lab; Warren Olson, Institute for Defense Analyses

Thursday, June 12,1530-1700

Why Aren't Mission Threads Good Enough?
George W. Hartwig, Jr., Ann E. M. Brodeen, and Maria C. Lopez, US Army Research Laboratory

AH-64 Longbow Apache Aim Point Error Analysis
Elliott Rickenbaker and Lloyd Browning, BDM, International; LTC Patrick Kastner, U.S. Army

A Joint Electronic Attack Mission Data Optimization Effort
Jerry D. Sowell, 53d Wing/68ECG/36ETS/EEA

WG 20 - TEST and EVALUATION - Abstracts

Tuesday, June 10, 1030-1200

Human Mounted Instrumentation System
Bruce P. Hunn, Air Force Flight Test Center

Developmental and operational testing involves the integrated assessment of multiple variables under a variety of test constraints. However, the assessment of the human-in-the-loop is primarily done post-mission. In the case of flight test, much of the data collected is subjective and memory dependent. Inherent limitations on the aircrew's ability to recall specifics of numerous and complex flight tasks restrict the level of detail available for post flight analysis. To counteract this human limitation, the Human Mounted Instrumentation System was developed. The system is self-contained, battery powered, ejection compatible, and can record aircrew audio communications, video from the aircrew's perspective, and a variety of aircrew physiological measures. The system is currently set up to record eye blinks, heart rate, and electroencephalography (EEG or brain waves) and can record over twenty channels of data. These physiological measures can provide an index to aircrew stress, workload, and physical condition. The helmet mounted video camera documents the environment experienced by the aircrew, and fulfills the dual functions of allowing evaluators to observe the details of test execution and providing objective data for post-test analysis. The system has utility for both single-operator systems as well as for the study of crew dynamics and training.

Assessment of the Air Combat Environment Test and Evaluation Facility (ACETEF) To Support Operational Test and Evaluation
John A. Bentrup, Center for Naval Analyses
Don Greaser, PRC, Incorporated
CDR Richard L. Bainbridge, Operational Test and Evaluation Force (OPTEVFOR)

The use of hardware-in-the-loop and man-in-the-loop simulation facilities may be one way to test more fully the electronic combat (EC) capabilities of increasingly complex aircraft electronic warfare (EW) systems. Critical assumptions and model limitations, however, may adversely affect results. Thus, realistic testing in a virtual world requires the proper verification and validation (V&V) of the environment and simulated emitters.

The Air Combat Environment Test and Evaluation Facility (ACETEF) is a full-spectrum EC test facility. One of ACETEF's labs—the Electronic Warfare Integrated Systems Test Lab (EWISTL)—can be linked with a manned flight simulator to provide a flight environment with an emitter variety and emitter density that is unattainable on any test range. ACETEF tests EW systems that are fully integrated aboard an operational mission aircraft.

At the request of the Commander, Operational Test and Evaluation Force (COMOPTEVFOR), we assessed the suitability of selected laboratories at ACETEF to support the operational test and evaluation (OT&E) of EW systems, in particular, the Navy's next-generation radar warning receiver (RWR), the AN/ALR-67(V)3. Our goal was to determine whether ACETEF provided a level and quality of data similar to those obtained during operational testing at an open-air test range and whether ACETEF's test support processes were mature enough to support the OT&E customer.

Based on our analysis of the models used, observations made during RWR testing, and comparisons of ACETEF-derived data to real-world data, we have identified and documented ACETEF's capabilities and limitations to successfully support OT&E. As a result of this assessment, OPTEVFOR is preparing a letter approving the use of these laboratories at ACETEF to support the OT&E of the AN/ALR-67(V)3.

Instrumentation Systems and Applicationsfor Electro-Optic (EO) Missile Warning Systems (MWS) Development and Testing
Dr. Charles Pender, Pender Technology; Patrick D. Quinn, SENTEL Corporation; Fred Sherrell, Sverdrup Technology

The increasing requirement for aircraft missile warning systems designed to detect and declare infrared threat missiles is leading to the development of highly sophisticated instrumentation. This instrumentation must have very high data rate capabilities, wide Field-of-Views (FOVs) and extremely high sensitivities. In addition the instruments must be rugged enough to withstand thermal and vibration shocks associated with use in hostile environments. Currently the 46th Test Squadron at Eglin AFB, FL in conjunction with the Arnold Engineering and Development Center (AEDC) at Tullahoma, TN is developing an instrumentation suite with these attributes.

The first use of this sophisticated instrumentation is the collection of signature measurements. These signatures are used for system algorithm development and for the development of Models and Simulations. Algorithm development is not limited to detection and declaration of threat missiles, it also includes the rejection of signals from sources such as engine exhaust, exploding bombs, flares and many other EO/IR sources. The Modeling and Simulation (M&S) community places a very stringent requirement on the instruments..

An ultraviolet radiometric instrumentation suite is being developed which includes: a mid UV imager, spectrometer and photon counting radiometers. The sensors are comprised of state of the technology components and are PC-based. The systems have been designed to have extremely high sensitivity and frequency response. The data handling systems can acquire large volumes of data and are capable of generating final data a short time following the acquisition of that data. New technology such as, Z-stack image intensifiers and optical fibers have been incorporated into the systems.

Tuesday, June 10, 1330-1500
Sensor Fuzed Weapon P^3I Optimization Tests
David M. Smith, KBM/TEAS

The Joint Munitions Test and Evaluation Office (CHICKEN LITTLE) has been an active participant in many phases of the SFW development since 1985. Included in this was characterization of the block 1,2, and 3 warheads, the Congressionally mandated LIVE FIRE Test and Evaluation, IOT&E I & II, Lot Acceptance Tests, Producibility Enhancement Program, and characterization tests to determine if a new fabrication process had any adverse affects on the warhead performance. The program is now beginning the pre-planned product improvement (P^3I) phase of development.

This paper will discuss the P^3I development and LIVE FIRE strategy for this warhead. It will cover the early static testing and results of the preliminary P^3I multislug warhead design. All of the presented P^3I testing and analysis were done at Eglin AFB by CHICKEN LITTLE. Initial design analyses were conducted to compare and optimize the performance of the P^3I main penetrator to the baseline SFW. The testing was required in order to provide empirical data to support the Point Burst Damage Assessment Model used for vulnerability analysis by CHICKEN LITTLE. The test results will also give the warhead designers a better understanding of how the design is performing and identify areas requiring improvement. The purpose in doing vulnerability analysis in conjunction with preliminary designs was to decrease the number of the tests required to achieve the final design. The reduction in testing directly correlates to time and cost savings to the SFW Program Office. The results of the tests will be discussed and the challenges involved in designing a cost effective test set up to acquire data on the main penetrator as well as the peripheral slugs will be presented.

Joint Stand-Off Weapon (BLU-97) Live Fire Test and Evaluation
Robert L. Stovall and Carson W. Sasser, 46 OG/OGML (CHICKEN LITTLE)

This paper presents results of the Joint Stand-Off Weapon (JSOW) Combined Effects Bomblet (BLU-97 A/B) LFT&E and summarize efforts conducted by the Joint Munitions Test and Evaluation Program Office (CHICKEN LITTLE), Eglin AFB FL in support of the JSOW Deputy for Test and Evaluation, Pt Mugu CA. The LFT&E consisted of five live F-18 launches of the JSOW/BLU-97 weapon onto a target array at the US Navy's NRaD Missile Impact Range on San Clemente IS CA (July - October 1996) and was conducted as part to DT&E (IIC) satisfying both requirements in the same tests. The array was composed of threats including trucks, aircraft, and radar controlled air defense guns. JSOW dispenses 145 BLU-97 bomblets onto the target array with pattern dimensions controlled by JSOW ingress and dispense conditions. The bomblets detonate on impact, sending a shaped charge jet in the direction of impact and launching roughly 350 pre-formed steel fragments radially. NAWS (China Lake) completed arena tests to quantify the bomblets performance characteristics. Logic for LFT&E pre-test target positioning and preparation, and post-test damage assessments, correlating observed damage to bomblet(s) causing the damage, are presented. Pre-test MxN target Pks were created using the Texas Instruments developed TRAJECT Model in combination with PDAM outputs. The test results are compared in detail with results

generated using CHICKEN LITTLE developed PDAM (Point-Burst Damage Assessment Model) on the basis of component level damage and system level target probability of kill. PDAM incorporates detailed 'hands-on' target models, warhead performance characteristics, bomblet impact metrics including range coordinates and impact angles (azimuth/elevation) as inputs, and calculates component level damage for each target, and aggregates the damage through the target fault trees to produce overall system Pks. A thorough review of JSOW/LFT&E Lessons Learned are presented and related in detail to PDAM validation and accreditation for JSOW/BLU-97 for use against the complete (15 target) JSOW analytical target set.

Application of Controlled Test Events to Interpretation of Real-World LIVE FIRE Events
Elizabeth T. Thorn, Sverdrup (TEAS); Norman D. Fleming,

Surface-to-Air Missile (SAM) systems are currently operational with the former Soviet Union forces and at least 25 independent countries. These threat systems are prime targets of concern for Lethal Suppression of Enemy Air Defense (SEAD) weapon development efforts. Analyses of various Air Defense Units indicate the potential for significant damage contribution from unlaunched missiles. The missiles in the SAM systems represent the largest single presented area item with the potential to cause a catastrophic kill. The target vulnerability community lacks test data on conventional and emerging kill mechanism effects on threat missile propellant and rocket fuel and has no accurate response models.

This paper presents the results of subscale and full scale testing of the SA-6, SA-8, SA-9, and SA-13 missile rocket motors versus a spectrum of kill mechanisms and methodology used to interpret CL experimental test response data to actual observed damage states in Joint Stand-off Weapon (JSOW) LIVE FIRE test events. Review of the results of this application of controlled test results to live test events indicate a new understanding in the phenomenology and successful application of controlled testing and analysis to real-world LIVE FIRE events. All testing and analysis was conducted by the Joint Munitions Test and Evaluation Program Office (CHICKEN LITTLE) at Eglin Air Force Base with tri-service working group involvement. LIVE FIRE testing was conducted at the Navy's San Clemente Island, California test range.

Wednesday, June 11, 0830-1000
****Risk in Weapon System Acquisition: An Approach to the Economics of Test and Evaluation***
Russell Lenz, 412TW/TS and Lee Gardner, 412 TW/TSDI

Approved abstract not available at printing.

****Using Risk Assessments to Determine Appropriate Operational Testing for Software Intensive Systems***
LCDR Dale Spaulding, LT Cynthia Womble, and LCDR Bill Campbell, COMOPTEVFOR

Many Navy software intensive systems are acquired and deployed in a series of incremental software releases. Traditional operational test and evaluation (OT&E) required distinct test phases prior to the deployment of each major release with little or no testing for minor and maintenance releases. In addition to the obvious challenge of developing an appropriate operational test (OT) for a software intensive system, the lines are often blurred between major, minor, and maintenance releases. It is unclear when and under what circumstances a dedicated phase of OT is required.

Director, Operational Test and Evaluation (DOT&E) published guidelines for the conduct of OT&E of software intensive system increments in October 1996. These guidelines discuss determining the appropriate level of OT by use of risk assessments performed by the Operational Test Agency (OTA). This paper will present COMOPTEVFOR's methodology for conducting risk assessments for software intensive systems. In addition, this paper will discuss case studies of risk assessments conducted using this methodology.

****Test Officer's Guide for Designing Valid Tests and Experiments***
Rick Kass, U.S. Army Test and Experimentation Command (TEXCOM)

Approved abstract not available at printing.

Wednesday, June 11, 1330-1500
Identifying the Imapct of Technical Issues on the Operational Performance of Weapon Systems
William J. Hughes, Evaluation Analysis Center, OTEC

The issue addressed in this paper is the integration of technical and operation issues to provide a single evaluation of U.S. Army weapon systems. With the consolidation of Army Evaluation into OPTEC, there is an ever greater need to integrate the technical and operational evaluations of weapon systems. In the past, developmental evaluations were conducted by AMSAA, and operational evaluations were conducted by OPTEC. These two evaluations were conducted, for the most part, independent of each other and sequentially. With the consolidation of Army evaluation directed by the VCSA, both the technical and operational evaluations are now the sole responsibility of OTPEC. This paper presents a methodology to identify the impact of technical issues on the operational performance of a weapon system. The methodology is based on a taxonomy developed by ARL that breaks down the analysis of a threat -- target interaction into 5 specific levels. The taxonomy begins with the definition of the threat, determines the specific damage caused by the threat and the impact of that damage on the capabilities of the system to perform its mission. This may then be used the operational evaluation to determine the battlefield utility of the weapon system. Finally the methodology also provides a mechanism to modularize the analyses required for an evaluation.

Non-traditional Operational Test and Evaluation to Support Non-traditional Acquisition
2Lt Alan Camp and Ms. Janelle Loper, Joint Interoperability Test Command; Mr. Dennis Ballard and Dr. Ernest Montagne, BDM International

To support the non-traditional acquisition strategy of the Global Command and Control System (GCCS), the Joint Interoperability Test Command (JITC) adopted an innovative, continuous comprehensive evaluation (CCE) strategy for operational test and evaluation (OT&E). JITC started early in the acquisition cycle and applied an "all-source data collection" methodology to support the evaluation. JITC fostered development of testable requirements through extensive coordination with the users and the Director, Operational Test and Evaluation (DOT&E). Capitalizing on a team approach, with representation from the Program Management Office (PMO), the users (represented by the Joint Staff, Commanders-in-Chief (CINCs), and Services, and the test community, JITC supported multiple Joint Staff decisions concerning incremental fielding of GCCS. JITC facilitated the T&E process by applying new technology such as the World Wide Web to collect test data and distribute test plans and reports.

Tactical Ballistic Missile Simulation in Support of Operational Testing of 3D Radar
Captain Raphael Brown, Marine Corps Operational Test and Evaluation Activity (MCOTEA); Mr. Philip C. Minor, SRI International; Mr. Ernest Rockwood, Sensis

Operational testing of the AN/TPS-59(V)3 3D radar, which had been upgraded to provide surveillance and early warning in an integrated Theater Missile Defense (TMD) system, posed a significant challenge in terms of presentation of a realistic target environment. The radar track initiation, and tracking accuracy performance requirements encompassed a broader range of Tactical Ballistic Missile (TBM) types, and launch/impact geometries than available live target missiles, such as Lance, and live fire test facilities at White Sands Missile Range could support. Moreover, radar requirements, and the corresponding hypothesis test design, called for a level of statistical significance that demanded a sample size in each performance regime that could not have been achieved cost effectively with live missile launches. Accordingly, the operational test activity, MCOTEA, determined that TBM simulation should be considered to supplement a limited number of live Lance missile launches in the operational test. In pursuing this course of action, MCOTEA sponsored the first ever validation review and approval of this class of threat simulator by the DoD Threat Systems Office [OUSD(A&T)/DTSE&E)]. This paper addresses the key operational test issues related to TBM simulation, the characteristics of the Radar Environment Simulator (RES) that was evaluated (validated and accredited) for use in the Initial Operational Test and Evaluation (IOT&E) of the AN/TPS-59 at WSMR in August and September 1996, the method and lessons learned in gaining DoD approval of the simulator validation, and a summary of the technical contribution to the Independent Evaluation Report (results of the IOT&E) which the RES provided.

Wednesday, 1530-1700
COMPOSITE GROUP V SESSION

Thursday, June 12, 0830-1000
Simulation in Support of Developmental and Operational Testing for the Predator SRAW
Matthew M. Aylward, Gary R. Brisbois, and Sara F. McCaffery, The MITRE Corporation

This paper describes MITRE's plan for using modeling and simulation (M&S) in support of concurrent Developmental Testing (DT) and Operational Testing (OT).

While there are many applications of M&S to DT, the unique requirements of OT (e.g., independence of the test agency from the acquisition force, and real Marines, in real environments doing the real things) mark it as fundamentally different from DT. Due to these unique requirements, the use of M&S in support of OT has been limited.

MITRE, in conjunction with the Marine Corps Modeling and Simulation Management Office (MCMSMO), the Marine Corps Systems Command (MARCORSYSCOM), and the Marine Corps Operational Test and Evaluation Activity (MCOTEA), is applying M&S to support the DT/OT of the Predator SRAW. This support is provided via the M&S/Hardware in the Loop (HITL) testbed. The testbed integrates a Predator SRAW Guidance Control Unit (GCU) with various models and simulations.

The testbed M&S components provide stimulation to the HITL. This stimulation models the inputs the GCU would receive prior to an actual firing. A six degree of freedom, physics based flight model simulates the missile flyout, reacting to output from the GCU. In addition, the GCU receives, and acts upon, simulated environmental stimulation (e.g., air temperature, wind velocity). An object oriented simulation environment mimics the functions of the weapon's sensors and the actuation of the warhead. This simulation environment is provided by a process model running in the Force Level Analysis and Mission Effectiveness System (FLAMES).

Modeling and Simulation in Navigation System Test and Evaluation
Major Eileen A. Bjorkman, 746th Test Squadron

The 746th Test Squadron at Holloman AFB, New Mexico, is responsible for test and evaluation of inertial navigation systems (INS), Global Positioning System (GPS) navigation systems and user equipment, and integrated INS/GPS systems. In the past, most of this testing included extensive and expensive laboratory and flight testing to determine system performance and model system characteristics. These tests are performed in both blue sky and jamming environments. The 746th Test Squadron recently developed a simulator, the Navigation Test and Evalution facility (NavTEL), which stimulates systems under test as though they were in an actual

flight environment. Flight profiles can be recreated to duplicate problems seen in flight. Jamming signals can be inserted directly into the system to simulate the jamming environment. NavTEL has been used extensively to investigate navigation system anomalies reported by operational crews on C-17 and C-130 aircraft. NavTEL is a proven, versatile, simulator which can be used to minimize flight tests or eliminate them altogether. This paper will discuss NavTEL development and current configuration, several past and current test programs, and plans for the future.

Captive Flight Test Planning and Playback System
Kirk L. Weeks, TASC

With increasing requirements and expanding roles for the limited smart weapons development programs, test and evaluation dollars become fewer while testing requirements expand. In order counter these diametrically opposed requirements and to maximize the information obtained from test and evaluation events, the Joint Muntions Test and Evaluation Program Office (also known as Chicken Little) has developed a capability to combine pre-test prediction tools with visualization techniques into a unique test and evaluation support tool. The tool operates on a Silicon Graphics O2 machine, and utilizes a combination of commercial off-the-shelf (COTS) software, government domain prediction codes, and custom software to provide a highly flexible tool to support pre-test prediction, real-time time-space-position information (TSPI) test visualization, and post test analysis functions, all within a single portable tool. The TSPI data stream is provided from a low-cost differential GPS system (also developed by Chicken Little) or from the GPS Range Applications Joint Program Office (RAJPO) pod systems. Other forms of TSPI information can be easily incorporated for display by the system. In addition to these capabilities, the system accepts and generates Distributed Interactive Simulation (DIS) compliant Protocal Data Units (PDUs) to support insertion of the system and the various TSPI sources into DIS test and training exercises. The presentation will provide an overview of the tool and development methodology, and will include a computer demonstration of the capability.

<u>*Thursday, June 12, 1330-1500*</u>
****Electronic Combat Data Exchange***
Mr. John Crane and Mr. Thomas H. Plank, Sverdrup Technology, Inc

Currently, sharing between the services of engineering and test data used to develop mission data for electronic combat (EC) jamming systems employed against common threats is limited. This results in duplication of effort and wasted time and money. The paper describes the Electronic Combat Data Exchange (ECDATX) system being implemented by the 36 Engineering and Test Squadron at Eglin AFB, FL. The system addresses the sharing of EC data throughout the DOD using existing communications links and the application of emerging Web technologies. The ECDATX home page (http:/143.157.16.1/) is available through the Secret Internet Protocol Router Network (SIPRNET) and provides access to EC data and analysis applications. As other users implement Web servers, ECDATX will evolve into a distributed architecture.

The paper includes an assessment of the ECDATX near-real-time data sharing capability conducted as part of a MOBCAP EAST ground mount evaluation. Test support personnel loaded data as it was collected on the ECDATX server at Eglin. Engineers at remote locations where able to analyze the collected data using the associated applications. The engineers where then able to recommend mission data modifications to on-site engineers that same day.

The Jammer Effectiveness & Techniques (JET) Web effort initiated by the Air Force Electronic Warfare Integration Office (AF/EWIO) is expanding the ECDATX data sharing concept to establish a community-wide, information sharing capability including developers, testers, and users. The JET Web architecture envisions linking different levels of critical and related information with an open architecture of data servers using current and emerging Web technologies.

****Visualization of Field-Collected Data***
Walter G. Butler, US Army TRADOC Analysis Center

A software package developed by TRAC-WSMR has significantly improved the analyst's ability to understand data obtained from operational tests and to determine the context in which the data should be interpreted. The Office of the Secretary of Defense, Director of Operational Test and Evaluation (DOT&E) commissioned TRAC-WSMR to develop the package, called Operational Test Visualization (OTVIS), to support the independent analysis of test data by the Institute for Defense Analyses for DOT&E. OTVIS has also been used by the TEXCOM Experimentation Center at Ft. Hunter Liggett, CA and by TRAC-WSMR's Model-Test-Model group. Tests and experiments supported by OTVIS include the Unmanned Aerial Vehicle preparatory tests, M1A2 IOT&E, NBCRS test, Longbow Apache IOT&E, AGS EUT&E, Focused Dispatch AWE, and the All Services Combat Identification Evaluation Team (ASCIET) '96 test. OTVIS uses data collected by field instrumentation to produce a visual replay of the trial. It displays a map of the test area and draws symbols to show the locations of participating units. OTVIS moves these symbols around the map according to the position location data obtained from the instrumentation. It displays shots taken by the participants at the time they occurred and a scoreboard of shots, hits, and kills for the entire trial or any portion. Thus the context of any engagement can be quickly determined. OTVIS has been used extensively by data authenticators to improve the validity of final data sets. It was a major part of the after action review process during ASCIET '96.

****McKenna Warfighter Evaluation***
John D'Errico and Dr. Eugene Dutoit; Dismounted Battlespace Battle Lab; Warren Olson, Institute for Defense Analyses

This paper will discuss the testing and evaluation of databases prepared for an urban training area at Fort Benning, Georgia. This is the McKenna MOUT (Military Operations in Urban Terrain) Site. The purpose of the project was to develop high resolution

mapping, charting, and geodesy data of use to the DoD modeling and simulation community. The presentation will discuss the details of the methodology developed to implement and complete the evaluation. Because the thrust of the evaluation was based on comparisons of digital products with ground truth; terrain walks were designed to have the test subjects see firsthand several points of interest to dismounted infantry. Many checkpoints were established along each route that could be linked back to products that were being evaluated. The details of the test design will be given to include; questionnaire construction, selection and assignment of test subjects, the description of the "ground truth routes", and the flow of the data analysis. The results of this analysis and the planned follow-up actions that are designed to improve the products will be given.

Thursday, June 12, 1530-1700

Why Aren't Mission Threads Good Enough?

George W. Hartwig, Jr., Ann E. M. Brodeen, and Maria C. Lopez, US Army Research Laboratory

For many years military command and control systems have been evaluated by the use of mission threads. Mission threads arise from operational requirements and are designed so that a system's response to a series of selected scenario events can be quantified. They may be used to answer timeline and routing questions such as: "How long does it take to complete a mission?", "How can information be more effectively routed?", or "Where are the delays in the mission threads occurring?". While this descriptive data is sufficient for the decision maker to judge a prototype command and control system on a pass/fail basis, it does not convey information about the performance of the communications system; in particular, it does not allow the accurate determination of throughput and delays. Mission threads do not allow human effects to be satisfactorily decoupled from the communications effects, thereby inhibiting the characterization of the types of delays a system may be experiencing. An in-house solution has been to generate "messages" that are simply character strings of a specified length and arrival rate. Test and evaluation software inserts the message strings into the communications system, and allows network statistics to be made accessible to the decision maker in an accurate and timely fashion. This paper describes the nature of mission threads, problems encountered with their use, and the effective use of message strings in simulation and experimentation.

AH-64 Longbow Apache Aim Point Error Analysis

Elliott Rickenbaker and Lloyd Browning, BDM, International; LTC Patrick Kastner, U.S. Army

Post-test analysis of AH-64D Initial Operational Test and Evaluation (IOTE) data revealed aim point errors for Longbow HELLFIRE missile engagements of enemy targets. The AH-64D Fire Control Radar (FCR) determines the aim point for an enemy target and passes target data to the HELLFIRE missile for an engagement. When the FCR aim point does not coincide with the enemy target's position, an error exist in both magnitude and direction. Aim point errors are realistic in weapon system targeting, but large errors can affect the operational effectiveness of a weapon system. The Longbow HELLFIRE missile is a fire and forget missile, which relies on accurate data to search for and acquire the target. Accurate data increases the probability of acquisition and the probability of a successful missile hit. Increasing the probability of hit means fewer engagements against a specific target and lower exposure to the threat. In turn, aircraft survivability improves and the combat attrition of assets decreases.

This presentation examines what variables and factors contributed to aim point error during the IOTE. Target movement, time to engagement, and engagement tactics, along with minor weapon system failures and changing AH-64D navigation solutions affect aim point variance. Over 400 enemy target engagements are studied with statistical methods: the W test for Normality, the Kolmogorov-Smirnov test, univariate linear regression, and physical reconstruction. Discussion and findings are presented in a clear, concise manner to benefit the operational user. This study also applies to all weapon platforms that require accurate target data and shows the effects of battlefield dynamics on targeting.

A Joint Electronic Attack Mission Data Optimization Effort

Jerry D. Sowell, 53d Wing/68ECG/36ETS/EEA

Defines the differences between Electronic Attack (EA) techniques and EA Mission Data (MD) from an operational perspective. Addresses the operational user's historical approach to ensuring operational MD robustness and the documented impact on the design of selected threat systems. Discusses the approach taken by the user to develop robust MD by the application of state-of-the-art technology to determine the "how and why" specific MD is effective.

Reviews the planning, conducting, and results of a joint effort (multiple services and contractors) to develop MD by using a secure wide area net to Near Real Time exchange test planning, data, analysis, and results.

A Joint Electronic Attack Mission Data Optimization Effort

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WG 21- UNMANNED SYSTEMS - *Agenda*

Chair: Mr. Thomas W. Haduch, U.S. Army Research Laboratory
Cochair (Air Force): Ms. Audree Newman, U.S. Air Force Studies & Analysis Agency
Cochair (Army): Mr. David Scribner, U.S. Army Research Laboratory
Advisor: Mr. Brad Bradley, U.S. Army Materiel Systems Analysis Agency
Room: MCRC – CR-125 and CR-134

Room: MCRC – CR-125

Tuesday, 1030-1100
Unmanned Ground Vehicle Man-Machine Interface Research
Mr. Thomas W. Haduch, U.S. Army Research Laboratory

Tuesday, 1100-1130
Unmanned Ground Vehicle Confederation of Models
Mr. Robin Whitworth, Unmanned Ground Vehicles/Systems Joint Project Office, Mr. Rob Elich, Summa Technologies

Tuesday, 1130-1200
Human/Computer Performance Analysis Architecture
Dr. Eric S. Yager, Mr. Paul N. Cobb, Mr. Michael A. Suarez, & Dr. Charles J. Jacobus, Cybernet Systems Corporation

Tuesday, 1330-1355
The Effect of Stereoscopic and Wide Field of View Conditions on Teleoperator Performance
Mr. David Scribner, U.S. Army Research Laboratory

Tuesday, 1355-1415
Towards a Constructive Simulation Model Incorporating Unmanned Mobility
Mr. Gary Haas and Dr. Mary Anne Fields , U.S. Army Research Laboratory

Tuesday, 1415-1435
Near-Real Time Multi-source Imagery Analysis for Unmanned Aerial Vehicle (UAV) Applications
Mr. Michael J. Barnes, U.S. Army Research Laboratory, Ms. Marsha McLean and Mr. Frank LaNasa, BDM Federal Inc.

Tuesday, 1435-1500
Army Force XXI Unmanned Aerial Vehicle (UAV) Requirements
Mary L. Horner and CPT Carlos Perez, U.S. Army, TRADOC Analysis Center

Wednesday, 0830-0900
Bird Dog: Coupling an Unmanned Aerial Vehicle to Manned
Ms. Michelle Pouliot and Mr. Jim Kolding, McDonnell Douglas Helicopter Systems

Wednesday, 0900-0930
High Altitude Endurance (HAE) Unmanned Aerial Vehicle/U2/Low Observable (HAE) Comparative Study
Jim Barnes, Major USAF, Manager Airborne ISR, Air Force Studies and Analyses Agency, AFSAA/SAA

Wednesday, 0930-1000
Use of Unmanned Surface Vehicles (USV) in Littoral Warfare
Mr. Joseph S. Johnson, Space and Naval Warfare Systems Command and Mr. Ace J. Sarich , Marine Acoustics, Inc.

Wednesday, 1330-1400
The Effects of Multiple Vehicle Control and Workload on the MDARS Operator Performance
Ms. Patricia M. Burcham and Mr. William B. DeBellis, U.S. Army Research Laboratory

Wednesday, 1400-1430
The Impact of Helmet-Mounted Displays on Visual Attention
Dr. Ann Marie Rohaly and Mr. Robert Karsh, U.S. Army Research Laboratory

Wednesday, 1430-1500
The Concerted Technology Thrust for DEMO III
Mr. Bailey T. Haug, U.S. Army Research Laboratory

Wednesday, 1530 – 1700
COMPOSITE GROUP V SESSION .... Ellis Hall

Room: MCRC – CR-134

Thursday, 0830-0900
Pervasive Technical Issues Related to Organic Mine Countermeasures
Mr. John Benedict, Johns Hopkins University/Applied Physics Laboratory

Thursday, 0900-0930
Performance Measures for Teleoperated Field Equipment
Von Ayre Jennings, Ph.D., Lockheed Martin

Thursday, 0930-1000
CECOM RDEC NVESD Unmanned Ground Vehicles Effort
Ms. Sally Lambert Bennett, U.S. Army CECOM, RDEC NVESD

Thursday, 1330-1430
Sensor Platform Allocator Model and Analysis Tool (SPAM/AT)
Ms. Audree Newman, U.S. Air Force Studies and Analysis Agency, Roy Rice, Ph.D., Teledyne Brown Engineering and Kurt Willstatter, MRJ Technology Solutions

WG 21 - UNMANNED SYSTEMS - Abstracts

Tuesday, 1030-1100
Unmanned Ground Vehicle Man-Machine Interface Research

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The U.S. Army Research Laboratory's Human Research & Engineering Directorate (HRED) is currently pursuing various research and development projects focused on investigating man-machine interface (MMI) issues associated with military unmanned ground vehicle (UGV) crew stations, to include developing methods of measuring, analyzing, and predicting operator performance and workload. The basic functions of unmanned and manned crew stations are to: (a) present information, (b) provide control interfaces, and (c) provide safety and comfort to the operator. The degree to which the crew station enhances these basic functions will determine the effectiveness of the entire system. With the onset of new machines of ever-increasing intelligence substantial task allocation changes will occur between the operator and the UGV, especially as we move away from fully teleoperated vehicles in the future. Even as UGV autonomous capabilities increase, there will remain a requirement to perform near real-time monitoring of as much data as possible in order to maintain military confidence in the system. Non-video sensor information merged with limited video information that utilizes imaging techniques for scene interpretation to provide information on terrain shapes, road conditions, and obstacles will be used as much as possible to supplement missing video information. This information coupled with graphic terrain overlays to create world models will become important MMIs to assist the operator in completing a remote mission, minimizing the need to transmit back real-time video information. This paper will discuss investigations aimed at assessing these MMI issues and the changes in operator performance and workload that occur as data transmission parameters and levels of UGV supervisory control change.

Tuesday, 1100-1130
Confederation of Models to support Unmanned Ground Vehicles/Systems Development

Mr. Robin Whitworth, Unmanned Ground Vehicles/Systems Joint Project Office

Mr. Rob Elich, Summa Technologies

Approved Abstract not available at printing

Tuesday, 1130-1200
Human/Computer Performance Analysis Architecture

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Cybernet Systems has implemented a comprehensive software architecture for the collection and analysis of human, computer, and systems performance data. This system has been designed specifically to integrate and synchronize data from multiple sources. Data sources need not be identical, and can include numeric data streams, keyboard and mouse events, physiological data, audio, and both analog and digital video. The user can select from a variety of analytical tools, ranging from data reduction functions to expert system modules. Our measurement system is completely user configurable, and its open implementation supports both real-time and post-collection analysis. These advantages allow the architecture to meet an unusually wide range of performance analysis needs. This tool-set has been successfully applied to a wide range of applications, including UGV control station design evaluation; satellite telemetry anomaly detection and diagnosis; design simulation recording, playback, and validation; and radio set test control; satellite telemetry anomaly detection and diagnosis; design simulation recording and playback; virtual environment validation. The resulting methodology of data fusion and analysis is directly relevant to many of the challenges of unmanned systems. This tool-set will allow us to empirically evaluate the performance of both humans and machines, and will provide valuable insight into the complex human-machine interfaces that are critical to the next generation of unmanned systems.

Tuesday, 1330-1355
The Effect of Stereoscopic and Wide Field of View Conditions on Teleoperator Performance

Mr. David Scribner
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A study was performed to examine the effects of stereovision, wide field-of view (fov), and their possible interaction on teleoperator performance. The study was a 2x2 randomized between-subjects design. There were 24 subjects in all, 6 per cell, in conditions of monoscopic-narrow fov, monoscopic-wide fov, stereoscopic-narrow fov and stereoscopic-wide fov. No significant interaction effects were found. However, an ANOVAs yielded significant differences on the mono-stereo dimension for error rate as well as reported motion sickness symptoms on the fov dimension. Self-reported stress levels from pre- to post-run also yielded significant differences on the mono-stereo dimension. Chi-Square Tests revealed significant findings of first choice of viewing condition which was stereoscopic-wide fov. Additionally, a second CHI-Square Test showed that wide fov was, to significant levels, the single most important viewing condition of all four. It is felt that with under a tactical driving task with no path cues (worn tire paths, etc) using terrain features and waypoint navigation, that fov would prove to be a significant effect condition and would also provide a significant interaction effect with stereoscopic vision for both time and error rate measures.

Tuesday, 1355-1415
Towards a Constructive Simulation Model Incorporating Unmanned Mobility

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The effective mobility of unmanned ground vehicles (UGVs) is a combination of vehicular mobility, the reasoning algorithms used to select paths and behaviors for the UGV, and the sensors and algorithms used to autonomously navigate the terrain. The operational effectiveness of a UGV in performing a mission is dependent on all of these components of mobility, yet the constructive simulations typically used to evaluate operational effectiveness do not model mobility, UGV or conventional, with sufficient fidelity to incorporate the components directly into the mobility algorithms. This paper describes models and measures used in autonomous navigation, path planning and vehicular mobility, and maps them into a UGV mobility algorithm suitable for constructive simulations.

Tuesday, 1415-1435
Near-Real Time Multi-source Imagery Analysis for Unmanned Aerial Vehicle (UAV) Applications

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Multisensor imagery analysis is an important issue for the 21st- century battlefield. For future unmanned aerial vehicle applications, near-real-time analysis of multisensor imagery will be a requirement for tactical operations: commanders will need multisource information as quickly as possible. A recent experiment conducted at Ft. Huachuca addressed a variety of training and design issues related to imagery interpretation. The results of the pilot study support the feasibility of using 96D or 96H soldiers to develop SALUTE reports in less than five minutes using moving-target indicator radar returns, static imagery, or dynamic imagery from a UAV source. The results are compared with previous experiments using 96 U payload operators. The importance of new training approaches, design issues, and possible workload problems are discussed. In particular, automation and correlation issues require further experimental investigation.

Tuesday, 1435-1500
Army Force XXI Unmanned Aerial Vehicle (UAV) Requirements

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In the late 1980s and early 1990s, the U.S. Army developed requirements for a family of three UAV systems aimed at satisfying ground commandersí AirLand Battle (ALB) intelligence needs. The three UAV systems were the Close Range (Brigade), Short Range (division and corps), and Endurance (Echelon Above Corps (EAC)) systems. The Operational Requirements Documents (ORD) for the family of Army UAVs reflect requirements under ALB doctrine, a doctrine that will be replaced by Force XXI. The doctrinal differences between Force XXI and ALB, the increasing joint nature of military operations, and the rapid advance in key information, sensor, weapons guidance, and signature management technologies will have a significant impact on future UAV missions, payloads, and UAV system characteristics and capabilities. Collectively, these will lead to new requirements for conducting traditional reconnaissance, surveillance and target acquisition missions as well as new UAV missions. TRADOC initiated a study of Army UAV requirements in the summer of 1996. The objectives of the study are, first, to identify Force XXI ground commandersí baseline UAV mission requirements. Second, to assess current UAV programs in light of Force XXI requirements in order to identify any shortcomings and to offer potential solutions. Third, to assess the implications to the U.S. Army of expanding beyond conventional UAV missions and payloads. This presentation will discuss UAV modeling and simulation techniques and measures used in the study to develop user requirements for Force XXI UAVs.

Wednesday, 0830-0900
Bird Dog: Coupling an Umanned Aerial Vehicle to Manned

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Approved abstract not available at printing.

Wednesday, 0900-0930
High Altitude Endurance (HAE) Unmanned Aerial Vehicle/U2/Low Observable (HAE) Comparative Study

Mr. Patrick Wheeler, U.S. Air Force Studies and Analyses Agency - Force Enhancement Division
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The Air Force Studies and Analyses Agency conducted a comparative analysis of the High Altitude Endurance Unmanned Aerial Vehicle (HAE), the U-2R, and the Low Observable High Altitude Endurance Unmanned Aerial Vehicle (LO HAE) for the Defense Airborne Reconnaissance Office (DARO). This analysis evaluated the ability of these three airborne Intelligence, Surveillance, and Reconnaissance (ISR), platforms to satisfy information collection requirements in four different theaters over four stages of conflict. Two large and two small theaters with various terrain features were represented. The four stages of conflict were Peace Time (CONUS Basing), Pre-Hostilities (Deployed), Hostilities (Stand-off), and Hostilities (Penetrating). This analysis used a unique methodology that combined a relational database application which read and filtered (translated) requirements from the Community Imagery Needs Forecast (CINF) data set, an area coverage program to establish visibility and coverage zones, and finally a spreadsheet program to tabulate coverage and revisit times necessary to meet CINF requirements. Cost data was incorporated with the spreadsheet data to estimate cost effectiveness (per requirement) for each of the airborne platforms performing in each scenario during each of the stages of conflict.

Wednesday, 0930-1000
Use of Unmanned Surface Vehicles (USV) in Littoral Warfare

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The U.S. Navy must support the changing Expeditionary Forcesí role that emphasizes rapid response to crises in littoral areas. Acquiring this capability with limited resources, a push toward reduced manning, and minimal risk to personnel points towards increasing use of unmanned sensor platforms. Unmanned surface vehicles (USV) can increase the capability and effectiveness of the Joint Theater Commanderís littoral reconnaissance and surveillance capabilities. The USV concept is a family of related autonomous and remote controlled small, high performance unmanned surface craft capable of carrying a variety of mission dependent payloads and having the following inherent advantages: Relatively inexpensive and small, Good endurance, speed, and sea state capability, Capable of operating in very shallow and restricted waters, Easily stored, handled and operated from a ship of opportunity, and Payload flexibility. Equipping USVs with mission specific payloads such as day & night video cameras, laser range finders; electronic intercept; or acoustic, oceanographic or hydrographic sensors provides a capability to conduct missions in: Littoral Targeting, Port & Coastal Surveillance,

Mobile Inshore and Undersea Warfare, Littoral ASW, Static ASW towed array, Clandestine Insertion & Extraction, Obstacle and Mine Avoidance, Mine Counter Measures, Hydrographic Reconnaissance, Oceanographic Surveillance, Battle Damage Assessment, Surface Torpedo, Non-Lethal Weapons Delivery, and Maritime Interdiction Operations. During recent field tests in the Arabian Gulf, a prototype USV has demonstrated its capabilities in day & night video imaging, detection of mine-like objects, hydrographic surveys and shallow water submarine detection using a towed array.

Wednesday, 1330-1400

The Effects of Multiple Vehicle Control and Workload on the MDARS Operator Performance

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The Mobile Detection, Assessment, and Response System (MDARS) is a supervised robotic security system with multiple semi-autonomous mobile platforms which operate under high level control of a remote host until an exceptional condition is encountered whereby human intervention is required. A Manpower-Based System Evaluation Aid (MAN-SEVAL) model was developed at the U.S. Army Research Laboratory's Human Research and Engineering Directorate (ARL-HRED) to assess the feasibility of one human guard monitoring, responding, and controlling as many as eight MDARS platforms. It was concluded that one guard could satisfactorily monitor, respond, and control eight MDARS platforms. A study to validate these findings is tentatively scheduled for June 1997. The study objectives are to measure and assess the guard's ability to monitor, control, and respond to eight MDARS platforms (four on patrol and four on charge); to determine adequacy of the user interface; to determine how much "free time" exists under varying workload levels; to assess human performance; and to monitor subject stress levels and assess the relationship between stress and performance. It is hypothesized that operators will perform significantly more secondary tasks under low workload with decreasing completion rates for medium or high workload conditions, and that the psychological stress measures will parallel these results. There will be at least 18 subjects who are experienced as a security guard. The study is a 1x3 repeated measures design with counterbalanced presentation order. The performance data, reaction time, task time, error rate, and stress measures will be analyzed with separate two-way analyses of variance (ANOVAs). If significant differences are detected among any of the ANOVAs performed, a Tukey comparison of means will be performed.

Wednesday, 1400-1430

The Impact of Helmet-Mounted Displays on Visual Attention

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Designers and users of helmet-mounted displays often assume that single-eye devices reduce operator workload relative to dual-eye devices by allowing two tasks to be performed simultaneously, one by each eye. In other words, the two eyes are assumed to constitute separate attentional channels. To test this assumption, we implemented a modified version of the useful field of view (UFOV) paradigm of Ball et al. (JOSA A 5:2210, 1988) to measure the effects of dichoptically divided attention on dual-task performance. Subjects localized a peripheral target within a semicircular region of 30 deg radius while simultaneously performing a foveal task. The degree of difficulty of the experiment was manipulated by varying the foveal task workload and the number of clutter (distracter) items in the periphery. The foveal and peripheral tasks were either presented to the same eye (monocular viewing) or different eyes (dichoptic viewing). Peripheral target localization performance was essentially perfect at all eccentricities for all of the non-clutter conditions: monocular and dichoptic viewing, low and high foveal task workload. Introduction of peripheral clutter caused a significant deficit in localization performance that increased with increasing target eccentricity. Similar to the non-clutter conditions, there was no difference in performance between monocular and dichoptic viewing. Thus, we find no evidence to support the assumption that dividing attention between two eyes allows dual tasks to be performed more efficiently than when attention is divided within the same eye, implying that the two eyes do not constitute separate attentional channels.

Wednesday, 1430-1500
The Concerted Technology Thrust for DEMO III

Mr. Bailey T. Haug, U.S. Army Research Laboratory

Approved Abstract not available at printing

Thursday, 0830-0900
Pervasive Technical Issues Related to Organic Mine Countermeasures

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JHU/APL has recently been involved in a series of operational effectiveness analysis studies related to minefield reconnaissance and/or mine detection and avoidance. As a result, various onboard and offboard system alternatives and their associated tactics have been assessed at the sensor, unit, and mission levels to establish potential contributions to organic mine countermeasure efforts. By the conduct of these studies, a unique perspective has been gained on the pervasive technical issues that will likely determine the degree of success of future organic MCM operations. Some of these include: a. The development of reliable computer aided detection algorithms for onboard search sonars to enhance the ability to discriminate clutter (and thus avoid a sea full of clutter objects), b. The ability of search sonars to exploit multipath in key littoral environments, i.e., the ability to maintain target echo coherence after multiple boundary interactions. c. The development of reliable computer aided detection/classification/identification (CAD/CAC/CAI) techniques for autonomous (untethered) offboard vehicles, both to manage the clutter and to make correct calls on actual mines, d. The development of safe, high density energy sources, e.g., for the employment of unmanned undersea vehicles (UUVs) on submarines, e. The ability to achieve high mission reliability with offboard vehicles conducting long endurance mine reconnaissance operations, f. The ability to reduce/control signatures on offboard vehicles to minimize their vulnerability to mines during reconnaissance missions, and g. The development of precise navigation techniques for offboard vehicles during long endurance reconnaissance missions, i.e., consistent with overall mission accomplishment.

Thursday, 0900-0930
Performance Measures for Teleoperated Field Equipment

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Approved abstract not available at printing.

Thrusday, 0930-1000
CECOM RDEC NVESD Unmanned Ground Vehicles Effort

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The goal of the Joint Robotics Program is to develop and field a family of unmanned ground vehicle systems in accordance with user requirements for a range of military applications. The program focuses on critical technology development from tele-operation to supervised autonomy. The Night Vision and Electronic Sensors Directorate (NVESD) has been responsible for evaluating and selecting candidate sensors for the Joint Robotics Program. This presentation will provide an overview of the efforts of NVESD in support of

Unmanned Ground Vehicle (UGV) developments. Details of NVESD support for the Joint Robotics Program to date, including the loan of sensors for testing and integration on various platforms, will be discussed. Descriptions and conclusions of the Concept Evaluation Programs for Pointman Sensor Enhancement effort, executed for the Early Entry Lethality and Survivability Battle Lab, will be provided. Additionally, a description of the NVESD sensor evaluation and candidate sensor selection process for DEMO III will be given. An overview of the future NVESD efforts in support of UGV development will be presented. NVESD goals include emphasis on the miniaturization of sensors for a highly mobile autonomous platform and common optics for multiple sensors.

Thursday, 1330-1430
Sensor Platform Allocator Model and Analysis Tool (SPAM/AT)

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SPAM/AT is a Mixed Integer Program (MIP) managed by the Air Force Studies and Analysis Agency (AFSAA) and developed by Teledyne Brown Engineering (TBE). It determines the optimal mix of intelligence, reconnaissance and surveillance (ISR) systems. The optimum is classified by one of several objective functions, including target coverage, acquisition and operating costs, and value of information collected. The allocation of sensor-platform resources are calculated for various target categories (includes IMINT and SIGINT), in multiple distance bands, during multiple time periods. Constraints include resource conservation from one time period to the next, platform attrition, number of additional sensors and platforms that can be added to an existing inventory, and intelligence collection thresholds. SPAM/AT has been applied by AFSAA to identify and evaluate force mix options for the Defense Airborne Reconnaissance Office (DARO). The process of deriving these force options with SPAM/AT provided DARO with insights regarding deficiencies in meeting target coverage requirements. DARO used these insights to develop recommendations for the Quadrennial Defense Review (QDR). SPAM/AT may be used as a stand-alone analysis tool or in combination with the Air Forceís Combat Forces Assessment Model (CFAM) to quantify the military worth of ISR systems to weapons employment. Output from SPAM/AT, such as percent target coverage and probabilities of battle damage assessment, may be input into CFAM to show how a particular ISR force mix may impact weapons employment and targets killed.

WG 22 - COST AND EFFECTIVENESS ANALYSES - Agenda
Chair: COL Bob Clemence, OSD PA&E
Co-Chair: Lt Col Phil Exner, OSD PA&E
Advisor: Mr. Mark Cancian, OSD PA&E
Room: C&SC – CR-227 and CR-147

Room: C&SC – CR-227

Tuesday, 1030-1200
Defense Program Projection (DPP) - Robust Analysis for Extended Planning
Mr. Philip A. Richard and Dr. Will Jarvis, OSD PA&E

Battle Cost: A Tool for Determining the Level of Investment in System Protection
Mr. William A. Hockberger, Independent Consultant

Tuesday, 1330-1500
Linking Procurement Dollars to A Force Structure's Combat Capability Using Response Surface Methodology
Maj James B. Grier, LtCol Jack A. Jackson, and LtCol Glenn Bailey, Air Force Institute of Technology

The Enhanced Strike Model: Trading Stealth, Standoff and SEAD via Optimization
Maj Kirk Yost, Operations Research Department, Naval Postgraduate School

Wednesday, 0830-1000
Using the Analytic Hierarchy Process in a Cost and Options Analysis
Mr. Don Olynick, Senior Systems Engineer and Ms. Robyn Kane, System Analyst, ANSER Corporation

Rapid Cost Analysis to Complex/Uncertain Environmental Regulation Development
MAJ Patrick J. DuBois, PhD. US Army Concepts Analysis Agency

Wednesday, 1330-1500
Evaluating the Contribution of GPS-aided Weapon Systems on the Battlefield
LT Michael Morell, GPS Joint Program Office and Mr. Steve Friedman, Veda, Incorporated

Wednesday, 1530-1700
COMPOSITE GROUP V SESSION..Ellis Hall

Room: C&SC – CR-147

Thursday, 1330-1500
Joint Logistics Analysis in Support of DoD Resource Allocation: DAWMS LOG
LTC Daniel T. Maxwell and Ms. Linda Coblentz, US Army Concepts Analysis Agency

WG 22 - COST AND EFFECTIVENESS ANALYSES - Abstracts

Tuesday, 1030-1200
Defense Program Projection (DPP) - Robust Analysis for Extended Planning

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The Defense Program Projection is a long-term projection of DoD programs based on the President's Budget FYDP and other official documents. It is the joint venture of OD PA&E and USD(A) API to meet Defense Management Review requirement for:

"...a rough, 20-year 'road map' of the modernization needs and investment plans of DoD projecting the impact of the Program Planning Objectives, and of additional modernization or replacement of major systems (e.g., ships, aircraft, tanks and satellites) expected by the Military Departments and Defense Agencies, against realistic levels of future funding."

The DPP effort results in a projection of the Future Years Defense Plan (FYDP) database twelve years beyond the end of the FYDP, currently out to FY 2015. Inputs to this analysis include the FYDP, analyst projections of the force structure, investment projections based on current service plans, as well as OD PA&E and USD(A) API projections of the consequences of those plans. The DPP includes high and low excursions as well as an analysis and characterization of the budget, policy, and affordability risk inherent in the projection. DPP data and analyses have been used in the past in supporting the Bottom Up Review (BUR) and will be used in the Quadrennial Defense Review.

The DPP study effort uses several measures of merit to determine investment adequacy and program supportability. These measures include average fleet age, age distribution, steady state procurement, affordability, and force modernization rate. A major portion of the DPP presentation to high level DoD officials consists of highlighting the extent to which service investment programs comply with these PA&E determined goals.

This presentation focuses on the process of determining, analyzing, and reporting investment program compliance with program goals.

Battle Cost: A Tool for Determining the Level of Investment in System Protection

Mr. William A. Hockberger, Independent Consultant
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Battle costs are defined in this paper as the hypothetical future cost that may be incurred by a system as a result of engaging in battle. They include both the costs of weapons and materiel expended and the costs of damage and destruction sustained by the system. Using naval ships as an example, the paper discusses how those hypothetical future costs can be estimated and traded-off against the real costs of investing initially in protective capabilities to avoid or reduce them. How to consider human casualties is also addressed.

Tuesday, 1330-1500

Linking Procurement Dollars to A Force Structure's Combat Capability Using Response Surface Methodology

Maj James B. Grier, LtCol Jack A. Jackson, and LtCol Glenn Bailey
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The Air Force needs to be able to quickly evaluate various alternative force structures with regards to its combat capability, measured in terms of theater level campaign objectives (CO). HQ USAF/XOM tasked HQ USAF/XPY to develop a "quick turn" tool to perform iterative "exercises" to evaluate and compare alternative force structures within 24 to 48 hours. This evaluation process needed to supply measures of the "health" of the Air Force program in light of the Defense Planning Guidance (DPG) and the Chairman's Program Assessment (CPA).

Using Factor Analysis and Response Surface Methodology, this research successfully developed a "quick turn" tool designed to capture the cost and capabilities of alternative force structures, linking dollars spent to campaign-level measures of outcome.

The Enhanced Strike Model: Trading Stealth, Standoff and SEAD via Optimization

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In 1995, the Air Force began testing the Combat Forces Assessment Model (CFAM), a large-scale optimization designed to replace three different optimization models used to determine conventional munitions requirements. Since that time, CFAM's use has been expanded to examine force structure tradeoffs, investments options, and even mobility issues. However, a major omission in CFAM is the ability to assign SEAD and escort jamming and control surface-to-air attrition. A new variant of CFAM, built for the USAF at the Naval Postgraduate School, does SEAD and jamming allocation and allows investigating tradeoffs between stealth, defense suppression, and standoff. We will brief the formulation of this model, which is a nonlinear constrained optimization, and some notional results.

Wednesday, 0830-1000
Using the Analytic Hierarchy Process in a Cost and Options Analysis

Mr. Don Olynick, Senior Systems Engineer and Ms. Robyn Kane, System Analyst
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This presentation discusses how the Analytic Hierarchy Process (AHP) was used in a Cost Options Analysis to provide a military client with the information needed to select the best alternative to improve a major Air Force weapon system.

Initially, Functional Objectives (FOs), Measures of Effectiveness (MOEs), and Measures of Performance (MOPs) were developed in line with the Air Force Modernization Planning process. The MOEs became the first level of criteria under the goal in an AHP structure, followed by the MOPs as sub-criteria and finally, the proposed alternatives at the bottom level of the hierarchy. Then, operator and technical analyst inputs were collected to derive the weights of all criteria. Next, performance data was collected and synthesized to compute the ratio scales for all proposed alternatives. Prior to the input of data, utility functions were developed to ensure all performance data across all criteria were in the same units. A separate structure to analyze the effectiveness, cost and technical risk of each alternative was designed. Finally, risk adjusted cost-effectiveness ratios for each alternative in a variety of scenarios were computed.

Five different alternatives were compared to the current system in order to evaluate the possibilities. This briefing will explain the methodology, discuss the MOEs and MOPs evaluated, and present sanitized results (to protect contractor and program identities) of the analysis in terms of cost effectiveness ratios.

Rapid Cost Analysis to Complex/Uncertain Environmental Regulation Development

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Clients or sponsors desiring the cost impact of developing environmental regulations are notorious for wanting results before complex and politically sensitive (uncertain) environmental regulations are complete. A solution to the dilemma, is the development of a user-friendly, interactive spreadsheet with @Risk Add-In that allows the user (analyst, client or sponsor) to create "what if" scenarios that automatically calculate the corresponding cost of the scenario. In a key environmental initiative, the US Army is working side-by-side with State of Utah environmental regulators to develop a Land Disposal Restrictions (LDR) rule to regulate the land disposal of hazardous waste in the state of Utah. During the development of the rule, the Army and the state were constantly requesting the cost impacts of key initiatives (LDR levels, exit levels) of the rule. In order to keep up with rapid changes in key initiatives, a user-friendly, interactive spreadsheet with @Risk Add-In was developed using the following steps: (1) Develop flowchart to model the path of common waste streams; (2) develop survey sheet by entering decision node questions from flowchart into column headings and waste stream names into row headings; (3) enter appropriate waste quantity and cost data into separate sheets; (4) combine the data from the sheets (cost, quantity, and survey) with multiple "IF" statements and formulas in a cost analysis sheet to obtain the cost impact of the initiative. Hence, the analyst or the client/sponsor obtains instantaneous, accurate cost feedback through the use of this user-friendly (everybody understands spreadsheets), interactive spreadsheet.

Wednesday, 1330-1500
Evaluating the Contribution of GPS-aided Weapon Systems on the Battlefield

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Approved abstract not available at printing.

Wednesday, 1530-1700
COMPOSITE GROUP V SESSION

Thursday, 1330-1500
Joint Logistics Analysis in Support of DoD Resource Allocation: DAWMS LOG

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The Deep Attack Weapons Mix Study (DAWMS) is a joint study that is attempting to identify the most cost-effective mix of weapon systems to support future combat operations. These potential mixes of systems require different types and levels of logistical support to sustain combat operations. This paper presents the methodology and tools that were developed to accomplish logistical analysis for "out-year" systems and concepts. Results of analysis will also be presented, as appropriate.

WG 23 - WEAPON SYSTEMS ACQUISITION - Agenda
Chair: Mr. Terry Cooney, Veda Incorporated
Room: C&SC – CR-108 and MCRC – CR-125

Room: C&SC – CR-108

Tuesday, 1030-1200
M & S Effectiveness in Weapon System Acquisition
Ms. Anne Patenaude - SAIC

Evaluating the Contribution of GPS-Aided Weapon Systems on the Battlefield
Lieutenant Michael Morell, GPS Joint Program Office (SMC/CZ) and Mr. Steve Friedman, VEDA

Tuesday, 1330-1500
A Process for Long Term Planning of Research, Development and Acquisition
Dr. Amon Birenzvige - Edgewood Research Development and Engineering Center

Quality Function Deployment as a Tool for Implementing Cost as an Independent Variable
Mr. David R. Wollover, SPARTA

Wednesday, 0830-1000
Simulation, Test and Evaluation Process (STEP) Guidelines
Mr. Richard Helmuth - SAIC

Wednesday, 1330-1500
Combat Forces Assessment Model Update
Maj. Kirk Yost - NPS

Joint Anti-Armor Special Study Item level Performance Analysis
Mr. Ronald Thompson, Mr. Lee Blankenbiller, et.al. – AMSAA

Wednesday, 1530 - 1700
COMPOSITE GROUP V SESSION..Ellis Hall

Room: MCRC – CR-125

Thursday, 0830-1000
Foreign Integrated Air Defense Systems Intelligence Analysis and Production
Mr. David Panson, NAIC

BIRD DOG: Coupling a Longbow Apache with an Unmanned Aerial Vehicle.
Ms. Michelle Pouliot and Mr. Jim Kolding, McDonnell Douglas Helicopter Systems

Thursday, 1330-1500
A New Approach To Vulnerability Assessment Applied To Longbow Apache
Ms. Paula R. Rennaker, McDonnell Douglas Helicopter Systems

WG 23 - WEAPON SYSTEMS ACQUISITION - Abstracts

Tuesday, 1030-1200
M & S Effectiveness in Weapon System Acquisition

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This paper documents some of the findings of a study commissioned to identify the effectiveness or value of M&S tools and processes in the acquisition process. There is pervasive evidence of Modeling and Simulation (M&S) being used efficiently and effectively in the DoD system acquisition process by every Service, though not in the same way and not yet seamlessly throughout a program. Both Government and Industry are identifying and developing tools that bring added benefit to their program's development.

Although M&S tools have long been used to support the systems acquisition process, advances in technology have made these tools more powerful and less expensive. This, together with declining resources and changing priorities, provided the right environment to use M&S as a key in finding better ways to develop and field new systems. Existing processes and emerging requirements have been supported by powerful new M&S tools which have been integrated into weapon system acquisition.

There still exist many challenges, technical, as well as cultural, that impede effectively utilizing M&S tools in the DoD acquisition process. A few of the key issues are discussed as well as specific findings and recommendations.

Evaluating the Contribution of GPS-Aided Weapon Systems on the Battlefield

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Approved abstract not available at printing.

Tuesday, 1330-1500

A Process for Long Term Planning of Research, Development and Acquisition

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Long term planning for material acquisition in the DoD has always been a difficult process because of (1) uncertainty of the needs and, (2) uncertainty about the state of the art in science and technology. This paper describes a process that provides the material developer and the user community the means to develop a long term Research, Development and Acquisition (RDA) plans in a logical manner. The process is applied to Chemical and Biological Defense Equipment as an example, but can be applied to other weapon systems.

The planning process consists of a combination of seminar war games and technology outlook workshop. It was applied to low to middle intensity operations as well as to Operation Other Than War (OOTW). The process is designed to:

1. determine the capabilities that will be needed in the future,
2. develop conceptual future hardware based on projection of the state of the art of science and technology,
3. measure the battlefield utility of the new conceptual equipment.
4. prioritize these technologies according to their (operational) value added on the battlefield, anticipated development cost, and probability of successful development.

The paper will describe, in some details, the various steps in the process. We will also describe how to determine the add-on value of future material on the future battlefield, and how to prioritize them using the Analytical Hierarchy Process (AHP) expert system. The paper concludes with "lessons learned" and recommendations.

Quality Function Deployment as a Tool for Implementing Cost as an Independent Variable

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The essence of Cost As An Independent Variable (CAIV) is using reliable tools to balance cost with mission needs for new program development. This paper responds to concerns over implementing CAIV for DOD acquisition programs that vary be scope, budget, and dimension. Perhaps no single CAIV implementation tool is robust enough to apply to all cases. However, we are interested in tools to implement CAIV for a maximum number of programs so to collect lessons learned and related beneficial aspects of the CAIV learning curve. This paper describes and illustrates Quality Function Deployment (QFD) as a CAIV implementation tool. A generic weapon system example is used. The example is complex enough to illustrate a fairly detailed QFD application. Six general steps are illustrated: (a) Identify and analyze customer needs and requirements, (b) identify technical performance measures (TPMs), (c) benchmark TPMs, (d) prioritize customer requirements, (e) describe the steps from establishing TPMs to identifying specific design characteristics, and (f) evolve TPMs into the follow-up design phase's requirements.

Wednesday, 0830-1000
Simulation, Test and Evaluation Process (STEP) Guidelines

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Under Secretary of Defense for Acquisition and Technology, The Honorable Paul G. Kaminski, in an address on October 3, 1995, announced he was "requiring that the Simulation, Test and Evaluation Process - let's call it - STEP - shall be an integral part of our Test and Evaluation Master Plans". In addition, he said " this means our underlying approach will be to model first, simulate, then test, and then iterate the test results back to the model".

This presentation will review the motivation for and value of an effective integration of simulation and test in the system acquisition process. It will describe the process developed by OSD and discuss the official guidelines for incorporating STEP.

STEP takes operational and system requirements as inputs, and produces information as an output. This information provides the decision maker a sense of how well the system is meeting the operational and system requirements and how well the risks are being managed. Central to the process is evaluation, both for live testing and simulation. Analysis is essential prior to testing to determine what is to be evaluated, during testing to support those activities and following testing to extract the information from those activities.

Wednesday, 1330-1500
Combat Forces Assessment Model Update

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In 1995, the Air Force began testing the Combat Forces Assessment Model (CFAM), a large-scale optimization designed to replace three different optimization models used to determine conventional munitions requirements. Since that time, CFAM's use has been expanded to examine force structure tradeoffs, investment options, and even mobility issues. However, a major omission in CFAM is the ability to assign SEAD and escort jamming and control surface-to-air attrition. A new variant of CFAM, built for the AF at the Naval Postgraduate School, does SEAD and jamming allocation and allows investigating tradeoffs between stealth, defense suppression, and standoff. We will brief the formulation of this model, which is a nonlinear constrained optimization, and some notional results.

Joint Anti-Armor Special Study Item level Performance Analysis

Mr. Ronald Thompson, Mr. Lee Blankenbiller, et. al.
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A Joint Staff Special Study Team was formed to look at anti-armor munitions across the services and to provide a recommendation for the optimum mix in the post 2005 time frame. In support of that effort AMSAA conducted an Item Level Performance Analysis.

The AMSAA analysis provided the effectiveness of 29 joint service munitions (Armor, Artillery, Fixed and Rotary Wing Aviation, and Infantry) against a comprehensive set of armored targets. Integration, analysis of results and findings (which built on the AMSAA Near (2005) and Far Term (2015) Anti Armor Resource Requirements (A2R2) Item level Performance Analyses) were also provided. The primary measure of effectiveness was probability of mobility or firepower kill, per munition fired, as a function of range. For direct fire systems, accuracy from a stationary firing platform to a stationary target was used as representative. Surface indirect fire system and aircraft sensor fuzed weapon effectiveness was based on a volley of twelve submunitions vs companies of thirteen moving tanks, thirteen moving BMP and a battery of 6 stationary howitzers. The number of kills in the array divided by the twelve munitions fired is the munition probability of kill vs that target. That probability is then used in the comparisons of direct and indirect fire systems.

The AMSAA analysis is being used in the development of the 1998-2004 mini POM and is also expected to be used in support of the Quadrennial Defense Review (QDR).

Thursday, 0830-1000
Foreign Integrated Air Defense Systems Intelligence Analysis and Production

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This presentation will discuss the new DoD IADS Support Program (DODISP) and how a new team has been formed to pool resources from several organizations to conduct IADS intelligence analysis and production. This approach eliminates redundancy and allows for a single point of contact for foreign "big picture" IADS intelligence, namely NAIC/GTI. To further help stretch resources NAIC/GTI is pioneering a new virtual production effort to bring the various team members together in a virtual environment to facilitate intelligence production electronically. IADS products are becoming paperless with a push towards total visualization techniques to illustrate the IADS, using point and click techniques to bring up details. Visualization will go hand in hand with modeling and simulation efforts beginning to take shape in GTI.

Modeling and simulation will play a key role in the analysis of foreign IADS. NAIC hopes to leverage off existing simulation tools with wide community acceptance as well as developing new tools that are required. Simulations may include integrating existing proven models into the simulation. Eventually NAIC hopes to have a completely interactive IADS simulation/visualization. The user will be able to play as an interactive participant at any point in the IADS. This could be from a pilots point of view inside the cockpit as he flies into an enemy IADS, to a radar operator on the ground watching his radar scope.

Modeling and simulation techniques will have to be flexible enough so that any type of IADS can be modeled quickly since it will be unrealistic to have an IADS model on the shelf for every country. As new IADS technologies evolve the simulations will also have to be able to adapt in order to provide accurate representations. We also hope to use our IADS models as customer products that can be combined and used with the customers own models and simulations where threat IADS modeling is required.

BIRD DOG: Coupling a Longbow Apache with an Unmanned Aerial Vehicle.

Ms. Michelle Pouliot and Mr. Jim Kolding
Operations Research Analysts
McDonnell Douglas Helicopter Systems
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Approved abstract not available at printing.

Thursday, 1330-1500

A New Approach To Vulnerability Assessment Applied To Longbow Apache

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Approved abstract not available at printing.

WG 24 - SOFT FACTORS IN MILITARY MODELING AND ANALYSIS - Agenda

Chair: Mr. Christopher G. Blood, Naval Health Research Center
Cochair: Mr. Gerald Halbert, National Ground Intelligence Center
Cochair: Mr. William Pugh, Naval Health Research Center
Advisor: Dr. W. Peter Cherry, Vector Research Inc
Room: C&SC – CR-109 and C&SC – CR-108

Room: C&SC – CR-109

Tuesday 1030 - 1200
Stressed Systems Study -- Phase II
Major Robert Nuanes, Air Force Studies and Analyses Agency

The Relation Between the Incidence of Psychiatric Casualties and Wounded in Action
Dr. Robert L. Helmbold, U.S. Army Concepts Analysis Agency

Application of a Fuzzy Inference Paradigm to Simulation of Soldier Behaviors
Victor Middleton, Simulation Technologies, Inc and George Mastroianni, U.S. Army Natick Research, Engineering & Development Center

Tuesday 1330 - 1500
Some Considerations on the Application of Soft Factors in Models and Simulations
Gerald A. Halbert, National Ground Intelligence Center

Development of a Group Effectiveness Questionnaire
Dr. Brian G. McCaughey, Independent Contractor

A Prototype Virtual Reality Trainer for Management of Head Trauma Patients
LtCol Annette Sobel & Dr Sharon Stansfield, Sandia National Laboratories

Wednesday 0830 - 1000
Casualty Projections for Ground Forces
Christopher G. Blood, Naval Health Research Center

An Event-Oriented Approach to Casualty Estimation
Dr. David L. Danner, Ideamatics, Inc.

Casualty Estimation for Forces Afloat
Jeffrey S. Marks, GEO Centers, Inc.

Wednesday 1330 - 1500
COMPOSITE GROUP VI SESSION .... Ellis Hall

Room: C&SC – CR-108

Wednesday 1530 - 1700
Amicicide in Context: The Problem of Friendly Fire
Dr. Charles R. Shrader, Independent Contractor

New Approach and Manual for Theater Ground Forces Battle Casualty Rate Planning
George W.S. Kuhn, Logistics Management Institute

Thursday 0830 - 1000
Pitfalls of Casualty Rate Point Estimation
Jamie Pugh, Naval Command, Control and Ocean Surveillance Center

Modeling Casualty Evacuation Assets in a Theater of Operations
Serge A. Matheny & David C. Keith, GEO Centers, Inc

Development of Combat Casualty Flow Models for Medical Supply Configurations
Dr. Paula Konoske, Naval Health Research Center

Thursday 1330 - 1500
Incorporation of Soft Factors into an Existing Casualty Assessment Tool
Michael P. Brunnick, TASC

Information Requirements in Future Medical Operations
Neil Carey, Corey Rattelman, & Hung Nguyen, Center for Naval Analyses

WG 24 - SOFT FACTORS IN MILITARY MODELING AND ANALYSIS - Abstracts

Tuesday 1030 - 1200
Stressed Systems Study -- Phase II

Major Robert Nuanes
Air Force Studies and Analyses Agency
The Pentagon
Washington DC 20330-1570
(703) 569-2142

The purpose of this study was to quantify and measure the negative effects of the current OPTEMPO/PERSTEMPO on people and equipment as well as to provide a set of observations and recommendationsthat mitigate the negative effects of stress. Analysts from Air Force Studies and Analyses (AFSAA) visited over 45 units (operational & support) to collect 33 personnel indicators and 11 equipment indicators of stress. In addition, anecdotal stories, records, and surveys were gathered. Observations were formed for particular units or systems. A spreadsheet model, "Unit's Comprehensive OPTEMPO/PERSTEMPO Estimator" (UCOPE) was developed and applied to determine, which indictors recorded the highest levels of stress; which unit(s) where the most stressed; and which 28 solutions (tailored to the particular unit) would help the stressed unit limit and/or meet taskings. Briefings have been provided to many members of the senior Air Force leadership up to and including the Air Force Chief of Staff. The study, along with the 7 observations and 6 recommendations have been well received. AFSAA is assisting Air Force Public Affairs in orchestrating maximum exposure of OPTEMPO/PERSTEMPO issues and will be consulting with an integrated process team (IPT) to study the impact of implementing and tailoring some of the solutions prior to a senior Air Force leadership meeting in June and prior to the initiation of Stressed Systems Study Phase III.

The Personnel Attrition Rate (PAR) Series of Studies: Focus on the Relation Between the Incidence of Psychiatric Casualties and Wounded in Action

Dr. Robert L. Helmbold.
US Army Concepts Analysis Agency
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(301) 295-5278

The Personnel Attrition Rate (PAR) series of studies took up many aspects of personnel battle casualties in land combat. These studies will be briefly reviewed to set the context. The remainder of this presentation will focus on psychiatric casualties and their relation to battle stress as represented by wounded in action. Beebe and DeBakey's famous book on Battle Casualties states that "The most uniform and strongest of these relationships [between battle and nonbattle casualties] is the correlation between wounding and psychiatric breakdown in combat troops." This presentation explores some data from army forced in World War I, World War II, and Korea. The aim is to determine whether these data exhibit a consistent relationship of psychiatric casualties to wounded in action for land combat forces.

Application of a Fuzzy Inference Paradigm to Simulation of Soldier Behaviors

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(937) 461-4606

Simulation Technologies, Inc (STI) of Dayton Ohio, in collaboration with the US Army Soldier System Command (SSCOM) and others, has been investigating issues associated with simulation of the behaviors of individuals and small groups for several years. Much of

this research has centered on the dismounted combatant, and has resulted in the development of the Integrated Unit Simulation System (IUSS) for the SSCOM. Historically, models of dismounted combatants were derived from models of large weapon platforms, such as airplanes and tanks. While treating the individual soldier as simply a smaller, slower, un-armored tank is adequate for higher echelon combat simulations, it fails to provide a robust paradigm for the examination of individual soldier behaviors, such as suppression. The IUSS attempts to overcome this problem by representing the individual soldier as a collection of physiological and psychological objects and associated processes, but we have found that discrete state representation of these processes is still inadequate for complex representation of behaviors. Accordingly, we have been studying the use of a fuzzy interface engine to simulate these behaviors. This paper presents our results to date.

Tuesday 1330 - 1500

Some Considerations on the Application of Soft Factors in Models and Simulations

Gerald A. Halbert, Stephen P. Ketterer, John R. Lynch
National Ground Intelligence Center (NGIC)
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(804) 980-7560

In complex and uncertain times we can no longer continue to analyze possible courses of action in models and simulations without considering how human factors affect the course of battle. The intelligence community has been fairly successful at providing information to users on the composition of unit strengths, and performance characteristics of ground forces equipment. Other "soft" factors quantifying how well a country's armed forces will perform on the battlefield has always been in the "too-hard-to-do" category. The National Ground Intelligence Center (NGIC) has developed a methodology that evaluates factors such as morale and cohesion, readiness, leadership, training and other factors to assist in quantifying how well countries may be able to fight. In addition to the factors developed by the NGIC, other factors such as sleep loss and the effects of weather on humans can affect the ability to make rational, timely decisions on the battlefield. The major problem with integrating "soft factors" into models and simulations is that the data bases required to draw on to develop weighting factors or other methods of portraying the effect of soft factors on the battlefield simply do not exist. Intensive dialog between the intelligence and modeling communities is required to meld conventional modeling techniques with new appraisals of enemy forces. This presentation discusses approaches being explored to improve models and simulations by information about human factors.

Development of a Group Effectiveness Questionnaire

Dr. Brian G. McCaughey
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One goal of military medicine is to provide high quality medical care during war to minimize morbidity and mortality. A way to achieve this goal is to have adequate medical resources for wounded personnel in place before combat begins. But it is difficult to determine what medical resources to deploy unless the numbers and types of casualties that are likely to be incurred are known. Various casualty projection models base their forecasts on incidence rates observed in past scenarios, expected variations with battle intensity, and weapons capabilities of particular adversaries. However, it is also important to factor in to U.S. casualty projections the anticipated "group effectiveness" of the potential adversary, that is, how well will they function together as a group to inflict casualties on U.S. forces.

Seven group effectiveness factors that likely impact unit cohesion have been identified. They are: leadership, upward vertical bonding, downward vertical bonding, horizontal bonding, training, loyalty, and mental quality. A questionnaire was then developed to aid in the quantification of these factors. The questionnaire consists of 84 questions which measure the above factors, while at the same time, assess response consistency, and realism in view of the organization. Preliminary testing of this Group Effectiveness Questionnaire (GEQ) indicate consistency between the explicitly stated views of the group characteristics within an organization and the views as measured by the GEQ responses.

A Prototype Virtual Reality Trainer for Management of Head Trauma Patients

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The multifactoral determinants of human performance are often overshadowed by psychological factors in operational environments. Specifically, environmentally-induced stressors may degrade individual/team decision-making, reaction time, effective communication, and survivability. Repetitive, realistic, multidimensional training is critical to assuring predictable, effective medical support under these conditions. Management of battlefield injuries, especially those with gross wounds such as traumatic injuries to the head, create an opportunity for "over-

training" in stressful environments. A fully immersive, multisensory virtual training will be described as "work-in-progress" for this application. This environment encompasses both the microenvironment, i.e. "virtual patient," and the macroenvironment, i.e. "virtual battlefield." This approach enables the monitoring of student performance within both worlds while incremental realistic stressors are superimposed.

Wednesday 0830 - 1000

Casualty Projections for Ground Forces

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Naval Health Research Center
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The FORECAS ground casualty projection system is an interactive tool designed to provide medical requirements specialists with estimates of the numbers of casualties that may be incurred during various combat scenarios. Additionally, FORECAS displays graphs of the expected pulses and pauses in daily casualty incidence providing medical planners with the maximum likely daily patient load. The projections provided by the FORECAS system include wounded-in-action (WIA), killed-in-action (KIA), and disease and nonbattle injury (DNBI) incidence for U.S. Marine forces. The casualty estimates are based on empirical data from four previous ground operations: U.S. Marines deployed to Okinawa, Korea, and Vietnam, and the United Kingdom Amphibious Force (UKAF) in the Falklands War. These historical data were analyzed to determine casualty and disease patterns for troops during various combat intensities; casualty and DNBI means were then incorporated into the FORECAS system, as were statistically significant trends. In order to further refine casualty estimates, two sets of variables impacting casualty rates -- societal/cultural factors and weapons inventories -- have been examined for the U.S and potential adversaries. Societal factors and weapons parity scores have been computed and incorporated into the FORECAS casualty projection system so that more accurate forecasts may be obtained.

An Event-Oriented Approach to Casualty Estimation

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(703) 903-4972

The purpose of this paper is to present a foundation for the estimation of casualties based on the occurrence of specific events rather than the passage of time for a population-at-risk. Specifically, the projection of casualties for the aviation combat element in a Marine Air-Ground Task Force is examined using sortie rates as the independent variable rather than population-at-risk. Comparisons of the impact of such a formulation with one based on population are made. The modeling of casualties typically has utilized the application of an incidence rate, r, against a population subject to casualties, P, for a specified period of time, t. The population subject to casualties, the population-at-risk, experiences an exposure or vulnerability which in turn can produce casualties. The theory behind such a formulation implies that the greater the exposure, the greater the casualties. Therefore, any increase in the incidence rate, duration or population-at-risk will generate increased casualties. In the simplest formulation, this relationship is linear (e.g., if the population doubles, then the casualties will double). More sophisticated formulations attempt to introduce distributions for rates over time and for variations in the exposed/vulnerable population. In certain instances, a formulation based solely on rate and population over time does not accurately reflect the incidence of casualties. Rather, the incidence of casualties is dependent upon other factors. Examination of casualty data shows that the incidence of aviation casualties is dependent upon the number of sorties flown and the intensity of anti-aircraft defense encountered during the sorties. This formulation has been incorporated into the Casualty Estimation Model (CASEST) used by the United States Marine Corps for estimating combat casualties for deployed units. A complete description of the USMC methodology for aviation-related combat casualties is presented. The applicability of this methodology for other event-driven activities is discussed.

Casualty Estimation for Forces Afloat

Jeffrey S. Marks
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Operations Research Division
Naval Health Research Center
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(619) 553-8393

Medical resource planning for naval combat operations requires projections of the numbers of casualties that may be incurred by shipboard forces. These casualty projections are required inputs to models that forecast the beds, medical equipment, evacuation assets,

and health care personnel needed to support an operation. Projections of casualties among forces afloat require two separate sets of forecasts. First, estimates must be made of the likely numbers of ships that will sustain hits by enemy forces, and second, the incidence of casualties aboard the individual ships must be projected. SHIPCAS projections are based upon empirical data of eighty naval operations during World War II which have then been adjusted to reflect changes in hit probability and casualty sustainment resulting from advances in weapons and changes to ship structures. The SHIPCAS system models casualties by allowing the planner to define a specific scenario in terms of U.S. task force composition, weapons systems possessed by the adversary, expected battle intensity, length of the operation, and whether it is a littoral or open ocean operation.

Wednesday 1330 - 1500

COMPOSITE GROUP VI SESSION

Wednesday 1530 - 1700

Amicicide in Context: The Problem of Friendly Fire

Dr. Charles R. Shrader
910 Forbes Road
Carlisle, PA 17013
(717) 249-5625

The Gulf War of 1990-1991 brought to public attention one of the oldest problems of warfighting: the unintentional killing and wounding of friendly troops by their own comrades. Indeed, the problem can be traced back in history at least to the times of the ancient Greeks, but before the Gulf War it was primarily a problem of concern to military professionals who understood that war is indeed a messy business. The instant reporting of the Gulf War in the news media focused heavily on the statistical data and the tragic human elements of the story which generated a sustained public outcry in the United States and elsewhere for a firm allocation of responsibility as well as for an immediate and final solution to the problem. Consequently, US political and military authorities scrambled to solve what many experienced soldiers realized was a particularly thorny and perhaps insoluble problem. Lost in the rush were such factors as the inherently dangerous and unpredictable nature of combat operations, the fact that public sensibilities may have changed although the problem had not, and conclusions reached in previous studies of friendly fire. In fact, US military authorities were not unaware of the amicicide problem, and there had been an on-going effort since the late 1970s to find a solution of what was known to be a serious problem in combat operations. The outcome was more or less general agreement that the original estimate that 2% of all casualties resulted from fratricide was probably far too low and that friendly fire casualties as a percentage of total friendly casualties was more likely in the range of 15-25%. The present investigation examines a number of friendly fire incidents by type, causative factor, and effect.

New Approach and Manual for Theater Ground Forces Battle Casualty Rate Planning

George W.S. Kuhn
Logistics Management Institute
2000 Corporate Ridge
McLean, VA 22102-7854
(703) 917-7246

The Joint Staff will make available in 1997 a new approach to estimating conventional battle casualties for theater ground forces, to be used with the Medical Analysis Tool (MAT) in the GCCS. A multi-year study of empirical data from World War II (Europe, the Soviet Union, North Africa, and the Pacific), Korea, the Arab-Israeli wars, and *Desert Storm* – also, with extensive NTC data – clearly reveals patterns of rates that are associated with patterns of operations. Using these associated patterns, a planner may build a reasonable overall rate profile for a projected operation by drawing from a wide range of rate possibilities and assigning rates as appropriate to various aspects of the operation. The new approach provides average rates for active and pause periods, permits defining a force's possible "hot spots" that are critical to resource planning, and shows how to apportion killed/captured/missing and wounded casualty rates (which the research demonstrates may vary dramatically). This approach is useful for Joint and Service planners – both for constructing rate profiles as estimates and for evaluating estimated profiles generated by other methodologies.

Thursday 0830 -- 1000

Pitfalls of Casualty Rate Point Estimation

Jamie Pugh
NCCOSC
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(619) 553-1632

Point estimates based on battle intensity are used by medical planners to determine supply and asset allocation. These estimates, based on historical data , are the mean rate for each specified battle intensity. Okinawa is considered to be one of the most intense battles

waged. This talk looks at the number of casualties planned assets would not have been able to handle for that battle if planning had been based on the actual mean rate for the battle. Alternative point estimates for use in stubby pencil calculations are suggested.

Projections of Required Casualty Evacuation Assets

Serge A. Matheny, David C. Keith
GEO Centers, Inc.
Operations Research Division
Naval Health Research Center
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Military medical readiness for ground combat operations requires projections of the casualty evacuation assets needed to transport the casualties incurred through the various echelons of medical care. The OPTEVAC planning tool has been designed to help minimize the needed evacuation assets by providing the optimal deployment locations of these transportation assets. This medical planning tool utilizes information on expected casualty rates, size of theater, desired treatment facility locations, troop deployment nodes, and types and numbers of available assets to drive the linear programming algorithms which determine the optimal transportation asset locations. User input is accomplished by prompting the planner for troop and facility locations on a grid scaled to represent the combat theater. The OPTEVAC system then uses a modified version of the Probabilistic Location Set Covering Problem (PLSCP) to determine the needed vehicles and to indicate their optimal deployment locations.

Optimization of Supply Configurations for Forward Medical Treatment Facilities

Paula J. Konoske, Ph.D.
Medical Information Systems
and Operations Research Department
Naval Health Research Center
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(619) 553-0730

The mix of medical supplies and equipment that are deployed to treat Marine combat casualties at an Echelon II level of care are determined by the compositions of the Authorized Medical Allowance Lists (AMAL) and Authorized Dental Allowance Lists (ADAL). It is critical that AMALs/ADALs are correctly configured so that sufficient and appropriate medical supplies are available to sustain the combat operation. Recent changes in Marine Corps doctrine and policy, as well as a reduction in expected casualties, warrant a reexamination, and possible revision, of existing AMAL/ADAL configurations. The goal of the present effort was to review the AMAL/ADAL compositions to ensure that they reflect the new doctrine and updated casualty estimates. First, algorithms were developed that tie specific medical resources to the clinical requirements associated with treatment of individual medical conditions at a forward echelon of medical care. These algorithms were then incorporated into a model which estimates the needed supplies and equipment based upon the overall expected casualty incidence, as well as the composition of the patient stream. This medical supply model uses information such as the type of conflict anticipated, the expected duration, and changes in medical doctrine to optimize supply configurations.

Thursday 1330 - 1500
Incorporation of Soft Factors into an Existing Casualty Assessment Tool

Michael P. Brunnick
TASC
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(703) 558-7400

ne casualty assessment model that would easily accept soft factor data and produce a valuable result is the ORCA model. It was developed when the Crew Casualty Working Group (CCWG) of the Joint Technical Coordinating Groups for Munitions Effectiveness and Aircraft Survivability (JTCG/ME&AS) was chartered to develop a way to predict operational casualties in personnel subject to a wide range of threat environments or "insults," while performing a wide range of military jobs. The result was the Operational Requirement-based Casualty Assessment (ORCA) computer code, which operates on the assumption that each person possesses 24 elemental physical and mental capabilities that allow him to complete a task. These 24 elements can be easily measured, and the effects of specific insults on these elements is likewise quantified. Next, every major military job was defined in terms of these 24 elements (as the minimum elemental requirements to perform the job) so that the two portions of the methodology could interface. This allows the code, when given the individual soldier's job or mission and given a specific insult, to tell the user what injuries the soldier has sustained and that particular tasks the soldier's injuries prevent him from accomplishing. Soft factors could be used as divisors or multipliers that affect the values of the existing elements in predictable ways. Certain

to cause physical shock which in turn decreases that soldier's cognitive mental processing by a predictable amount. Likewise, then, it could be expanded to show that a severe injury can also be a serious psychological trauma which will also decrease a soldier's cognitive mental processing by a predictable amount.

Information Requirements in Future Medical Operations

Neil Carey, Cori Rattelman, and Hung Nguyen
Center for Naval Analyses
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Alexandria VA 22302-0268
(703) 824-2356

New concepts of operations for the Navy and Marine Corps will complicate the task of treating casualties. It will be more difficult to locate casualties and evacuate the injured, the average casualty may have to wait longer before being moved, and a buddy or corpsman may need to provide more extensive treatment. This investigation sought to determine the Navy's medical information requirements under these conditions. First, the probability of a casualty occurring was determined using patient flow data. Then a clinical database was used to identify the patient conditions which required specific medical tasks. Focus groups of operational medicine personnel were then employed to determine the tasks most likely to require teleconsulting. These steps gave us the probabilities that consultations would be needed under operational conditions. The results of the analyses yielded recommendations for modifications to the training given to casualty treatment personnel; new, augmented communication systems in support of medical functions were also proposed.

WG 25 - SOCIAL SCIENCE METHODS - Agenda
Chair: Dr. Jock O. Grynovicki, ARL
Cochairs: Hugh A. L. Dempsey, LMTF
Dr. Annette Ensing, MITRE
Dr. Michael Ingram, TRADOC
Gilbert G. Kuperman, Armstrong Lab
LTC Annette L. Sobel, United States Air Force
Dick Steinberg, W.J. Schafer Assoc
Advisor: Dr. James C. Geddie, ARL
Room: C&SC – CR-228 and MCRC Auditorium

Room: C&SC – CR-228

Tuesday, 1030-1200
The Qualitative Evaluation of Exploratory Wargames: An Application to the Army After Next (AAN) Winter Wargame (WW)
Dr. Walter Perry & Dr. Michael Ingram, TRADOC Analysis Center

Some Considerations on the Application of Soft Factors in Models and Simulations
Mr. Gerald Halbert & Mr. Steven Ketterer & Mr. John Lynch, NGIC

The Army After Next - A Multidisciplinary Approach to Envisioning Warfare in 2020
Dr. Michael Ingram, TRADOC Analysis Center

Tuesday 1330-1500
Performance Measurement Methods in Joint Training Assessment
Mr. Michael Wagner, Dynamics Research Corporation & Dr. David Promisel, ARL

The Personnel Attrition Rate (PAR) Series of Studies: Focus on the Relation Between the Incidence of Psychiatric Casualties and Wounded in Action
Dr. Robert L. Helmbold, US Army Concepts Analysis Agency

Ergonomic Design Analysis of a Mobil Command and Control System Using Human Figure Modeling
Mr. Richard McMahon, ARL

Wednesday 0830-1000
Central Technical Support Facility: Interoperability Testbed/Training Facility for Force XXI Automated Command and Control Systems
Ms. Sherry Hannan, Advanced Concepts Directorate

A Calibration Study of the Mobile Army Camouflage Evaluation (MACE) System Using Human Camouflage Effectiveness Judgments
Mr. Kragg Kysor & Dr. Jock Grynovicki & Mr. Michael Golden, HRED, ARL

OPMS XXI - An Integrated Strategy to Develop Officers for the 21st Century
LTC Aleks Rohde, OPMSXXI Task Force

Wednesday, 1330 – 1500
COMPOSITE GROUP VI SESSION .... Ellis Hall

Room: MCRC Auditorium

Wednesday 1530-1700
3D Sound Localization in a Virtual Environment
Mr. Doug Savick & Ms. Andrea Krausman, HRED, ARL

Stressed Systems Study Phase II
MAJ Robert Nuanes, Air Force Studies & Analyses Agency, Pentagon

Simulating Nonlinear Conflict Dynamics
Mr. Thad Brown, Department of Political Science, Univ of Missouri

Soldiers Involvement in Designing Displays for the Theater High Altitude Area Defense (THAAD) System
MAJ Elton Akins, THAAD Program Office & Mr. Richard Steinberg, W.J. Schafer Assoc

Thursday, 0830-1000
Human Systems Interface (HSI) Issues in Assisted Target Recognition
Mr. Gilbert Kuperman, Armstrong Lab, WPAFB

Near Real-Time Multisource Imagery Analysis for Unmanned Aerial Vehicle Applications
Mr. Michael Barnes, ARL; Ms. Marsha McLean & Mr. Frank LaNasa, BDM Corporation

The Logistics Anchor Desk - Supporting the CINCs Campaign Plan
Mr. Hugh Denny & Ms. Patricia Jones, HRED, ARL

Thursday, 1330-1500
Quantal Response Models Under Nonmonotonicity
Dr. Barry Bodt, ARL

Using Q-Analysis to Detect Information Warfare
M. Coombs, M.A. Staffeldt & A. Taha, New Mexico State University

A Cognitive Network Simulation for Modeling the Commander's Intent
Dr. Celestine A. Ntuen, NCA&T & Dr. Rene de Pontbriand, ARL

Determinants of Battlefield Training Strategies
Dr. Franklin Moses & Dr. Angelo Mirabella & Mr. Edward Matto, ARI

Thursday, 1530-1700
Human Systems Interface Optimization of DMA Products
D.L. Aleva, C.S. Calhoun, J.A. Selvaraj, B.Rogers-Adams, Armstrong Laboratory

Improving Speech Recognition Using Techniques for Spatializing Sound
Mr. Tuyen Tran & Dr. Kim Abouchacra, ARL & Drs. Besing & Koehnke, Univ of South Alabama

Simulating Nonlinear Conflict Dynamics
Dr. Thad A. Brown, University of Missouri

Usability Testing of System Status Displays for the THAAD Radar
LTC Michael Perrin & Mr. Bobby Ford, THAAD Program Office & Mr. Richard Steinberg, W.J. Schafer

WG 25 - SOCIAL SCIENCE METHODS

Tuesday, 1030-1200
The Qualitative Evaluation of Exploratory Wargames: An Application to the Army After Next (AAN) Winter Wargame (WW)

Dr. Walter L. Perry
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Approved abstract not available at printing.

Some Considerations On The Application Of Soft Factors In Models And Simulations

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In complex and uncertain times we can no longer continue to analyze possible courses of action in models and simulations without considering how human factors affect the course of the battle. The intelligence community has been fairly successful at providing information to users on the composition of unit strengths, and performance characteristics of ground forces equipment. Other ìsoftî" factors quantifying how well a country ís armed forces will perform on the battlefield has always been placed in the ìtoo-hard-to-doî category.

The National Ground Intelligence Center (NGIC) has developed a methodology that evaluates factors such as morale and cohesion, readiness, leadership, training and other factors to assist in quantifying how well countries may be able to fight. In addition to the factors developed by the NGIC, other factors such as sleep loss and the effects of weather on humans can affect the ability to make rational, timely decisions on the battlefield.

The major problem with integrating ìsoft factorsî into models and simulations is that the data bases required to draw on to develop weighting factors or other methods of portraying the effect of soft factors on the battlefield simply do not exist. Intensive dialog between the intelligence and modeling communities is required to meld conventional modeling techniques with new appraisals of enemy forces. This presentation discusses approaches being explored to improve models and simulations by including information about human factors.

The Army After Next - A Multidisciplinary Approach to Envisioning Warfare in 2020

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The Army After Next (AAN) program was chartered to project a vision of future military operations out to about the year 2025. The program includes an annual cycle of events to identify and address issues associated with developing and fielding future forces. The key event in the cycle is the Winter Wargame, a policy/strategy level game set in the year 2020 to raise such issues through player discussions and the employment of national future forces. The U.S. Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC) served as the lead analytic agency for the Winter Wargame, integrating strategic and operational level insights; TRAC also orchestrated a multy-phased Tactical Wargame to provide insights for adjudicating game play at the Winter Wargame. This presentation details the multidisciplinary approach employed to address TRADOCís issues during the FY 97 AAN cycle.

Tuesday, 1330-1500
Performance Measurement Methods in Joint Training Assessment

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The Joint Staff (J-7) and the Joint Warfighting Center are implementing a process by which joint force commanders analyze their missions and establish mission requirements. These requirements are described using a common language of tasks, conditions, and measures of performance contained in CJCSM 3500.04A, the Universal Joint Task List (UJTL). These requirements provide a basis for planning, conducting, and assessing joint training in accord with processes described in CJCSM 3500.03, the Joint Training Manual.

The most recent version of the UJTL, approved in September 1996, contained a separate menu of measures of performance for each of the tasks included in the UJTL. A project is underway to validate some of the measure of performance relevant to the mission of combating terrorism. This presentation will focus on the methods used to develop the measures of performance contained the UJTL, the methods used to validate some of these measures of performance, and methods by which performance data generated during exercises and operations using these measures can be used to make decisions related to training (CINC development of Joint Training Plans), readiness (development of inputs to the Joint Monthly Readiness Report), acquisition (development of assessments of JWCA functional areas), etc.

The Personnel Attrition Rate (PAR) Series of Studies: Focus on the Relation Between the Incidence of Psychiatric Casualties and Wounded in Action

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The Personnel Attrition Rate (PAR) series of studies took up many aspects of personnel battle casualties in land combat. These studies will be briefly reviewed to set the context.

The remainder of this presentation will focus on psychiatric casualties and their relation to battle stress as represented by wounded in action. Beebe and DeBakeyís famous book on Battle Casualties states that, ìThe most uniform and strongest of these relationships [between battle and nonbattle casualties] is the correlation between wounding and psychiatric breakdown in combat troops.î This presentation explores some data from army forces in World War I, World War II and Korea. The aim is to determine whether these data exhibit a consistent relationship of psychiatric casualties to wounded in action for land combat forces.

Ergonomic Design Analysis of a Mobil Command and Control System Using Human Figure Modeling

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This report documents an analysis performed by the U.S. Army Research Laboratory, Human Research and Engineering Directorate to support the development of a mobile command and control vehicle (C2V) for corps level and below battlefield operations. A computer-based, three-dimensional, model of the C2V was developed using computer aided design (CAD) techniques and computer software generated human figures were positioned within the C2V model using a program called ìMannequin®î. The use of these modeling techniques allowed for an ergonomic analysis which could provide preliminary assessment of crew reach, comfort, and field of view without having physical system mock-ups or live crews. The analysis was performed to estimate the degree to which the currently configured preproduction prototype system design was compatible with the intended soldier crews.

Wednesday, 0830-1000
Central Technical Support Facility: Interoperability Testbed/Training Facility for Force XXI Automated Command and Control Systems

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The armed forces are progressing rapidly toward digitizing the battlefield. There are numerous complex automated systems (initiatives) being put into tactical vehicles and weapon platforms. Each of the Program Managers (PM) responsible for the development of these initiatives are busy optimizing each of their respective systems. However, the optimization of each initiative is typically done in a ìstovepipeî method. Meaning that each of the systems undergo limited integration testing with other systems. The initiatives generally first get integrated when participating in an exercise or experiment such as Task Force XXI. This leads to numerous problems when each system has to ìtalkî or pass information on to another system. It also leads to problems when the digital data is moved over the existing tactical communications network (s). The common theme that each initiative is experiencing is a lack of ìinteroperabilityî. There is a great need for a central location where the PMS can have their system tested/evaluated for interoperability before participating in a test or exercise.

The Force XXI Integration Office (FIO), Program Executive Office Command, Control, and Communication Systems (PEO C3S) has established the Central Technical Support Facility (CTSF) at Fort Hood, Texas, to provide an ìinteroperabilityî capability. The CTSF provides the infrastructure/environment to evaluate/test system interoperability on a continuous basis. The mission of the CTSF is five fold: 1. Test/Evaluation-evaluate/test system integration, 2. Engineering-integrate common products into a baseline Battlefield

Functional Area (BFA) systems, 3. Training-provide an environment to train the user of the systems, 4. Configuration Management (CM)- maintain cm of the systems, and 5. Field Engineering-support Army and Joint exercises, demonstrations, and symposiums. Each of these areas will be further detailed in the paper.

A Calibration Study of the Mobile Army Camouflage Evaluation (MACE) System Using Human Camouflage Effectiveness Judgments

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Typically, the evaluation of prototype camouflage patterns is performed in field trials through the use of numerous groups of observers who rate the effectiveness of various patterns against different backgrounds. Large field studies are difficult to conduct, hence, the Mobile Army Camouflage Evaluation (MACE) system was developed as a cost effective means to automate the process of evaluating camouflage effectiveness.

A calibration study of the MACE system was conducted by determining the relative importance of each of the 54 MACE measures in predicting human subjective ratings of camouflage effectiveness. Specifically, weighting coefficients for MACE system measures were based upon soldier ratings of the effectiveness of five different camouflage patterns correlated with the MACE system measures of the target ensemble patterns and their associated backgrounds. The resulting rank order for the five camouflage patterns studied against a woodland background was (1) woodland, (2) olive drab, (3) black, (4) gray, and (5) desert.

In order to determine the relative importance of the MACE system variables to estimate the soldier rating responses, a principal components analysis showed a set of 16 variables that correlated with the rater's judgements. The eigenvalue weights suggested that the variables relating to the overall lightness difference between the target and background contributed most of the explanatory variance. The next most important variables were those relating to the yellow-blue color scale.

Based on the preliminary analysis, an equation consisting of six predictor variables was developed. This regression model produced a multiple R of .93 ($F(6)=332.6, p<.01$). Its reliability was statistically estimated to be .90. Thus, the six-predictor model was considered to be efficient and potentially useful.

OPMS XXI - An Integrated Strategy to Develop Officers for the 21st Century

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Approved abstract not available at printing.

<u>Wednesday, 1530-1700</u>
Simulating Nonlinear Conflict Dynamics

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Approved abstract not available at printing.

3D Sound Localization in a Virtual Environment

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Stressed Systems Study Phase II

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The purpose of this study was to quantify and measure the negative effects of the current OPTEMPO/PERSTEMPO on people and equipment as well as to provide a set of observations and recommendations that mitigate the negative effects of stress. Analysts from Air Force Studies and analyses (AFSAA) visited over 45 units (operational & support) to collect 33 personnel indicators and 11 equipment indicators of stress. In addition, anecdotal stories, records, and surveys were gathered. Observations were formed for particular units or systems. A spreadsheet model, "Unit's Comprehensive OPTEMPO/PERSTEMPO Estimator" (UCOPE) was developed and determined, which indicators recorded the highest levels of stress; which unit(s) where the most stressed; and which of the 28 solutions (tailored to the particular unit) would help the stressed unit limit and/or meet taskings. Briefings have been provided to many members of the senior Air Force leadership up to and including the Air Force Chief of Staff. The study, along with the 7 observations and 6 recommendations have been well received. AFSAA is assisting Air Force Public Affairs in orchestrating maximum exposure of OPTEMPO/PERSTEMPO issues and will be consulting with an integrated process team (IPT) to study the impact of implementing and tailoring some of the solutions prior to a senior Air Force leadership meeting in June and prior to the initiation of *Stress Systems Study Phase III*.

Soldiers Involvement in Designing Displays for the Theater High Altitude Area Defense (THAAD) System

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Approved abstract not available at printing.

Thursday, 0830-1000
Human Systems Interface (HSI) Issues in Assisted Target Recognition (ASTR)

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The capability to rapidly and accurately detect, locate, track, identify, and attack mobile targets is critical to national defense. Automatic target cueing and recognition (ATC/ATR) systems have been proposed to satisfy these requirements. Although the military services have invested hundreds of millions of dollars in advanced sensors, high speed processors, and target recognition algorithm development and demonstration program programs, over the past two decades, reliable, fully automated systems have yet to be demonstrated. Recently, the defense community has focused its attention on addressing the operational requirements through the application of ìassistedî target recognition systems (in contrast to ìautomaticî target recognition systems). Given this shift in emphasis (and expectation), it is incumbent on the research and development communities to address the unique issues which arise from the introduction of performance-aiding technologies into current and maturing weapon systems. Attention must be paid to the interface between the hardware/software subsystems and the human operator: the human-system interface (HSI).

The thesis that fully automated systems are beyond current capabilities is substantiated by both the recent (1996) House Permanent Select Committee on Intelligence report titled "Intelligence Community in the 21st Centuryî and the current Defense Science Board Task Force on Image Based ATR Objectives which suggest that the acronym ASTR (for assisted target recognition) is more appropriate than the acronym ATR in describing systems that may be fielded in the decade. These sources recognize that computers offer the advantage of high speed screening of massive amounts of data but that the human still provides the only capability for satisfying

cognition-based tasks. As a general observation, the problem is exacerbated by the drawndown of military forces; fewer imagery analysts (IAs), often of lesser experience than was true in the past, are being called upon to exploit more numerous and diverse sources of imagery intelligence. A similar situation may exist for weapon system officers (WSOs) in attack aircraft.

This paper presents the rationale for replacing ATR with ASTR. It reviews several current technology development programs. In providing context for the reader, the paper explains how ATR and HSI technologies are represented within the Defense Technology Area Plan (DTAP), prepared and published by the Joint Directors of Laboratories (JDL), which presents the science and technology efforts supporting the development of critical defense technologies. The paper adopts a cognitive engineering framework in exploring how ASTR concepts fit within the structure of the Observe-Orient-Decide-Act (OODA) loop model of human-system interactions. This exposition is extended by presenting the cognitive hierarchy in terms of a sequential set of value-adding transformations of raw data into predictive models. Data correlation and fusion are specifically addressed. The relative strengths and weaknesses of the human operator viz. a viz. automation are also presented and compared.

The body of the paper addresses the specific HSI design issues raised by the ASTR concept. Three main issues are addressed: increased workload, exploitation of non-literal intelligence sources, and requirements for correlation and fusion. Approaches to these issues are identified and discussed in the areas of personnel selection and training, human perceptual capabilities, human cognitive capabilities, and human-centered measures of effectiveness and performance. The application of HSI technologies to the design and conceptual demonstration of ASTR workstations is also discussed.

Near Real-Time Multisource Imagery Analysis for Unmanned Aerial Vehicle (UAV) Applications

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Multisensor imagery analysis is an important issue for the 21st century battlefield. For future unmanned aerial vehicle applications, near-real time analysis of multisensor imagery will be a necessity. Commanders will need multisource information as quickly as possible to fight the immediate battle. A recent experiment conducted at Fort Huachuca investigated a variety of training and design issues related to multisource imagery interpretation.

The results of the pilot study support the feasibility of using 96D or 96H soldiers to develop SALUTE reports in fewer than 5 minutes using moving target indicator radar returns, static imagery, or dynamic imagery from a UAV source. Soldiers from both MOSs were able to extract the essence of the military situation from the various imagery sources within the time allowed. The results were compared with previous experiments using 96U payload operators. The importance of new training approaches, design issues, and possible workload problems will be discussed. In particular, automation and correlation issues require further experimental investigation.

The Logistics Anchor Desk - Supporting the CINCs Campaign Plan

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This paper will address the technical and functional aspects of an OSD sponsored project that applies Artificial Intelligence technology to address the military logistics functions that are critical to successful battle commanders. This project, The Joint Logistics Advanced Concept Technology Demonstration operates under novel Department of Defense guidelines outside those covered in DODI5000 Evolutionary Acquisition Strategies. The technology deliverable of this program is called the Logistics Anchor Desk (LAD). The LAD is a prototype logistics operation cell where current logistics information is a readily available and powerful analytical tool and simulations provide the capability to examine CINC war fighting sustainment issues.

<u>Thursday, 1330-1500</u>
Quantal Response Models Under Nonmonotonicity

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Quantal response models are a general tool for describing the effect of varying levels of some stimulus to the distribution of binary responses of a population. There roots are in biological assay, but a history of application can also be found in the evaluation of stress-strength behaviors in material science, the evaluation of penetrator or armor performance in ballistics, and item response modeling for measurement in education and psychology. The motivation for the discussion in this talk was a recent study in ballistic limit estimation conducted for the Joint Technical Coordinating Group - Aircraft Survivability (JTCG-AS) where a common assumption for quantal response models was determined invalid. This talk will review the conditions for valid implementation of quantal response models and illustrate the results of failing to meet those conditions. The talk will also address an ad hoc procedure to account for deviation from the standard assumptions in the JTCG-AS testing environment and conclude by drawing parallels to the psychological testing arena.

Using Q-Analysis to Detect Information Warfare

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We use Q-analysis to model research on mathematical programming and case studies in which mathematical programming solves "real-world" problems. Over the period 1975-1995, we want to detect the impact of polynomially bounded algorithms for linear programming and the emergence of customized computer systems for applications. In the context of information warfare, our example will demonstrate how Q-Analysis can detect trends in military, cultural or financial situations.

Q-analysis uses geometry and algebra to describe complex systems. For the geometric representation, we identify major parts of a system with vertices in a network. Relationships that characterize the system become sets of vertices called simplices. For computational purposes, we code the system as a binary matrix, in which the columns correspond to vertices and the rows to simplices. In social, military and organizational settings, Q-analysis has proved its explanatory value by revealing significant insights about a system through study of its connective structure. Our example is part of a program for extending Q-analysis beyond the study of static systems to a tool that first tracks, and eventually controls, the evolution of a complex system. By varying the size of our example, we also have a basis for evaluating the computability of Q-analysis. Finally, since spatial presentation is not the primary source of the connective structure in our example, we consider context-based summaries of Q-analysis.

A Cognitive Network Simulation for Modeling the Commander's Intent

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Approved abstract not available at printing.

Determinants of Battlefield Training Strategies

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Thursday, 1530-1700
Human Systems Interface Optimization of DMA Products

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With the changing character of warfare, information superiority is a high priority. More than ever before, coordination among our own forces and with our allies for coherent combined air, land and maritime force operations requires that everyone involved share a common knowledge of the battlespace. Digital map and imagery displays will play a critical role in providing a common battlespace picture.

Our warfighters are now in the transition phase from reliance upon paper maps and charts to use of digital maps and imagery. Defense Mapping Agency has moved aggressively to take advantage of new digital storage and reproduction technologies to serve the diverse needs of its DOD customers. The use of these technologies has introduced new problems, however, one of which concerns the legibility and interpretability of the products.

Armstrong Laboratory has created a warfighter-centered knowledge engineering process focused on the utility of the new products. A field survey was conducted which utilized knowledge elicitation techniques including concept mapping, structured interviews, informal discussions and aircraft environmental measurements. This data was used to build an extensive database of user requirements for mapping, charting and geodesy (MC&G)-related information. Human factors issues associated with display of MC&G information were identified and documented.

Improving Speech Recognition Using Techniques for Spatializing Sound

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Monitoring radio traffic is a difficult task facing soldiers from all branches of the U.S. Army. The purpose of the present study is to determine the effect of sound presentation mode on a soldier's ability to monitor target (T) messages in the present of synchronous competing (C) messages. Twenty-eight normal-hearing subjects listened to T- and C-messages that were randomly selected from four lists of 104 sentences (10-syllable sentences such as, "Troy write the number one on the blue star," that were recorded by four male talkers). These messages were presented in four modes: (1) through loudspeakers located in a sound-treated room at 45°, 135°, 225°, and 315° azimuth (re: 0° azimuth-the position directly in front of the subject); (2) diotically under earphones; (3) dichotically under earphones; and (4) in a virtual environment with virtual sound sources located at approximately 45°, 135°, 225°, and 315° azimuth under earphones. In each presentation mode, the T-message was presented 40 times to the subject in the presence of 0, 1, 2, and 3 C-messages and subjects were required to manually record the T-messages. Following a set of 40 trials, subjects were asked to (a) rate their ability to understand the T-messages on a 5-point scale, (b) estimate the percentage of T-messages correctly recorded, and (c) describe any listening strategies that were used during trials. As expected, performance decreased as the number of C-messages increased for all presentation modes. When T-messages were presented with no competition, all subjects scored 100% in each of the four listening modes. Poorest performance

occurred when T-messages were presented in the other presentation modes, with highest performance occurring with all messages spatially separated (i.e., presentation modes 1 and 4). A detailed description of the performance data, followed by a summary of subject ratings and estimations will be presented and discussed.

Simulating Nonlinear Conflict Dynamics

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Approved abstract not available at printing.

Usability Testing of System Status Displays for the THAAD Radar

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WG 26 – LOGISTICS - Agenda
Chair: Mr. Alan R. Cunningham, TRADOC Analysis Center
Cochair: LTC Charles Shaw, Naval Postgraduate School
Advisor: Dr. Alfred G. Brandstein, USMC, CDC
Room: C&SC – CR145 and CR-140

Room: C&SC – CR145

Tuesday, 1030-1200
The Logistics Anchor Desk - Supporting the CINCs Campaign Plan
Mr. Hugh M. Denny and Ms. Patricia Jones, U.S. Army Research Laboratory

Modeling Logistics in Full Spectrum Operations/Military Operations Other Than War (FSO/MOOTW)
LT Jeff D. Goodmanson, Naval Postgraduate School

Tuesday, 1330-1500
Development of the ILOTS Model for Joint Logistics Over the Shore Planning and Operations
Dr. Jmmy E. Fowler and Dr. Donald T. Resio, USAE Waterways Experiment Station

Logistics Simulation Model of Maritime Prepositioning Ships Instream Offload
Dr. Keebom Kang, Naval Postgraduate School

Comparing Alternative 2015 Force Structures re Amphibious Lift and Landing
Mr. Fritz H. Brinck, Naval Surface Warfare Center

Wednesday, 0830-1000
Readiness Based Sparing at the Retail Level
Mr. Kevin Shorter, U.S. Army Material Systems Analysis Activity (AMSAA)

Identifying Opportunities to Improve Materiel Management: Balancing Resources and Risk
Ms. Anne J. Hale, Center for Naval Analyses

DLA Performance Metrics - Applying Supply Chain Management Techniques to Improving Weapon System Support
Mr. Gary W. Arnett, Synergy, Inc.

Wednesday, 1330-1500
COMPOSITE GROUP VI SESSION .... Ellis Hall

Room: C&SC – CR-140

Wednesday, 1530-1700
Modeling Integrated Logistics Support Operations for "Fighter Wing Equivalents" Through Dynamic Simulation
LTC Stephen R. Parker, U.S. Army Concepts Analysis Agency, and Mr. Patrick M. Williams, BDM Federal, Inc.

Use of the Generalized Air Mobility Model (GAMM) in the U.S. Army Ch-47D Sustainment Study
Mr. William Palmer, TRADOC Analysis Center, and Peter Wagner, General Research Corporation

Thursday, 0830-1000
Joint Logistics Analysis in Support of DoD Resource Allocation: DAWMS LOG
LTC Daniel T. Maxwell and Ms. Linda Coblentz, U.S. Army Concepts Analysis Agency

Optimizing Combatant Ordnance Loadout in Support of Naval Surface Fire Support (NSFS)
LT Stanfield L. Chien, Naval Postgraduate School

Logistics in JWARS
Major Barry D. Justice, JWARS Office, OSD(PA&E)

Thursday, 1330-1500

Reducing the Footprint of a Combat Service Support Element
Dr. Kevin R. Gue, Naval Postgraduate School

Counter Logistics Through Network Interdiction
LT Sean T. Moriarty, Naval Postgraduate School

The Personal Attrition Rate (PAR) Series of Studies: Focus on the Relation Between the Incidence of Psychiatric Casualties and Wounded in Action
Dr. Robert L. Helmbold, U.S. Army Concepts Analysis Agency

Thursday, 1530-1700
Air Mobility Express (AMX) Air Force Airlift Requirements
Mr. Jack R. Coley, Jr. And Mr. Dana L. Hill, Dynamics Research Corporation

WG26 - LOGISTICS - Abstracts

Tuesday, 1030-1200
The Logistics Anchor Desk - Supporting the CINCs Campaign Plan

Mr. Hugh M. Denny and Ms. Patricia Jones, U.S. Army Research Laboratory
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This paper will address the technical and functional aspects of an OSD sponsored project that applies Artificial Intelligence (AI) technology to address the military logistics functions that are critical to successful battle commanders. This project, The JL-ACTD operates under novel Department of Defense (DOD) guidelines outside those covered in DODI 5000, Evolution Acquisition Strategies. The technology deliverable of this program is called the Logistics Anchor Desk (LAD). The LAD is a prototype logistics operation cell where current logistics information is a readily available and powerful analytical tool and simulations provide the capability to examine CINC war fighting sustainment issues.

Modeling Logistics in Full Spectrum Operations/Military Operations Other Than War (FSO/MOOTW)

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Because the nature of FSO/MOOTW are significantly different than traditional combat missions, the simulation and analysis of these topics lag far behind combat modeling. In the area of logistics, this is particularly true since even traditional combat models lack sufficient logistic planning and analysis tools. The purpose of this study is to support the efforts of USPACOM in development of logistics and mobility planning tools for FSO/MOOTW. A large body of work has been completed on planning and analysis tools for U.S. military forces. However, the nature of FSO/MOOTW has driven a requirement for tools that would include non-U.S. military, and non-military personnel as well as their logistics assets and non-traditional material.

The first step to accomplish this is to define an FSO.MOOTW logistically. The variety of missions that are defined under this term mean there are a wide variety of participants and some missions may overlap. This often depends on the perspective of the particular CINC. The next step is to conduct a survey of existing models in all services that perform logistics functions. From this survey, it can be determined where some methods or fuctionality may be useful to modeling a FSO/MOOTW scenario. The data Necessary to develop a model and the sources, U.S. and non-U.S., must also be determined. The study will not present a model, but rather a design architecture for follow-up efforts in modeling FSO/MOOTW.

Tuesday, 1330-1500
Development of the ILOTS Model for Joint Logistics Over the Shore Planning and Operations

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Engineers and scientists at the U.S. Army Engineer Waterways Experiment Station (WES) and the Military Traffic Management Command (MTMC) are developing the Integrated Logistics Over The Shore (ILOTS) Model. When completed in FY 98, ILOTS will be most valuable when used as an assessment tool, allowing commanders to evaluate various LOTS alternatives such as site selection, asset assignment, and potential return on proposed investments in new LOTS technology. The model will be used in the planning mode to select optimum sites by incorporating hindcasted wave conditions at potential LOTS sites and predicting throughput for each. ILOTS will augment MTMC's Port Simulation (PORTSIM) model by forecasting LOTS assets required to offset shortages of throughput through inadequate or damaged existing ports. For use in a real-time operational mode, ILOTS will allow commanders to rapidly assess impacts of adverse weather , damaged or lost assets, and quickly choose the best available course of action, such as diverting or relocating assets to minimize disruption to the overall operation. The ILOTS model will be Higher Level Architecture compliant and will be integrated into the Force Projection Model as part of PORTSIM, ultimately becoming a key part of the solution to the military's LOTS problems.

Logistics Simulation Model of Maritime Prepositioning Ships Instream Offload

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The Maritime Prepositioning Force (MPF) of the U. S. Marine Corps enables a rapid and sustainable military response to short-warning global contingencies. To minimize response time without overtaxing available sealift and airlift assets, the entire complement of weapons, equipment, and supplies required for three Marine Expeditionary Brigades (MEB) is prepositioned aboard three squadrons of Maritime Prepositioning Ships (MPS), a total of thirteen U. S. Navy ships. Each MPS is capable offloading either pierside or instream in an area which is devoid of significant enemy threat. The pierside offload is preferred due to its speed and safety. However, port facilities may be sabotaged or mined to deny access. A highly urbanized area surrounding the port may impede vehicle movement, impose space restrictions, and favor terrorist actions. Thus, the instream offload proves strategic planning flexibility when a port is either unavailable or undesirable for offload. With the ship anchored offshore, all vehicles and containers are lifted onto floating lighterage which shuttle the gear from ship to shore, and Combat Service Support Area (CSSA). This operation is slower, more dangerous, and sensitive to environmental and terrain factors. Congestion at the beach area must be minimized by the efficient allocation of material handling equipment. We have developed a simulation/animation model to analyze the flow of cargo offloaded from the ship, across the beach and delivered to CSSA during an MPS instream offload. This model will enable the commander to best employ his assets rapidly and achieve full operational capability ashore.

Comparing Alternative 2015 Force Structures re Amphibious Lift and Landing

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This briefing presents a study conducted in support of a multi-lab FY95/96 Joint Littoral Warfare (JLW) Strategic Planning Effort led by the Naval Surface Warfare Center Dahlgren Division in support of OPNAV N85/86. The study makes a comparison of amphibious ship-to-shore lift capabilities of two alternative 2015 force structures. The comparison is in terms of the buildup ashore of assault echelon troops, vehicles, and cargo. The two forces are the 2015 DoD Baseline, i.e., the POM force, and the JLW 2015 Alternative Force - a JLW strategic planning force concept. The Force Potential Estimator (FPE) model developed in Dahlgren was used to compute the buildup. The JLW Force is a highly mechanized, mobile USMC MEB with USA augmentation and a large number of AAAVs. Its landing craft include a conceptual non-air cushioned, 3-tank-capacity LC(X). The presentation will address study assumptions, force and lift composition, and the resulting buildup. The preliminary conclusion is that the heavy JLW force can accomplish at least as quick a buildup ashore as the lighter baseline force.

Wednesday, 0830-1000
Readiness Based Sparing at the Retail Level

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Historically, the Army has based peacetime retail stocks of Class IX repair parts on the rules established by Army Regulation (AR) 710-2, which sets specific levels of demands to add or retain a particular part to the units' Authorized Stockage List (ASL). This process does not account for the cost of the individual repair parts or the readiness goals the unit commander has for the weapon systems. The U.S. Army Materiel Systems Analysis Activity (AMSAA) has developed a Readiness Based Sparing (RBS) methodology that will determine stockage levels for an ASL that will meet the commander's readiness goals while reducing investment costs.

RBS has been demonstrated in the Active Army at the National Training Center, Fort Irwin, California, and the 5th Infantry Division (Mechanized), Fort Polk, Louisiana. The results of those demonstrations were encouraging (increased supply performance, maintained/increased readiness, reduced ASL cost), however, Army leadership requested a "pure" demonstration prior to any possible implementation of RBS as the Army standard. The Army National Guard is currently demonstrating "pure" RBS ASLs at three sites, and a demonstration of a "pure" ASL in the Active Army is being prepared. This briefing will discuss current results and analysis in terms of cost, supply performance (accommodation, satisfaction, fill rate, zero balance rate) and readiness.

Identifying Opportunities to Improve Materiel Management: Balancing Resources and Risk

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The purpose of this study was to help the Navy improve its asset management process by analyzing tradeoffs between logistic resources (such as retail and wholesale inventory and repair capability) and readiness. We analyzed how these resources can be balanced to achieve desired readiness without increasing cost in a future logistics support environment with total asset visibility (TAV) capability. In particular, we showed how an advanced integrated information system, like TAV, will help the Navy decrease LRT and thereby reduce support costs. With each new support option we looked at, we quantified the risk associated with it in terms of readiness. Our risk analysis showed that if the logistic assumptions the Navy makes in resource determination do not actually hold up in operations, then there could be substantial risk to operational performance.

Our analysis showed that major reductions in LRT cannot be achieved until TAV and/or other process improvement initiatives have been fully implemented. We estimated that lowering the LRT equivalent parameters in today's retail allowance determination models from 25 to 15 days could reduce inventory cost by as much as 20 percent (which is about $740 million in FY 1995 dollars) with little risk to readiness. Once low response times can be met reliably, the cost of retail inventories can be further reduced up to about 31 percent, which would roughly equate to a one-time inventory "savings" of $1.1 billion.

Military decision makers can use our analysis to help them decide which new logistic strategies to select in their quest for dramatically transforming logistics support processes.

DLA Performance Metrics - Applying Supply Chain Management Techniques to Improving Weapon System Support

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Successful achievement of required operational readiness or mission capable rates for Service "Level A" weapon systems is directly related to the responsiveness of the supporting logistics system. Previous DLA studies have shown that current performance measures for stock availability are good indicators of the state of military readiness. However, it appears that the greatest returns on investment in terms of improved weapon systems mission capable rates can be achieved by concentrating on those items determined to be mission critical. As an example, of the 29,718 items managed by DLA for the C-5B aircraft at Dover AFB, DE, only 2,647 items are identified by the customer as critical to the mission capable status of the aircraft. DLA needs greater visibility of their performance in

terms of supplying these critical parts to DOD customers. DLA is fully committed to providing the highest quality customer support to ensure a maximum state of readiness for Service weapon systems.

The ultimate objective of this initiative is to improve DLA support by focusing DLA resources and redefining its business practices to increase peacetime military readiness and if necessary wartime sustainment. The major objective of this project will be to develop a set of metrics and a prototype performance measurement system for eight "Level A" weapons systems, two from each Service. DLA customers at the field or unit level and depot maintenance facilities will be included in the development of the customer base for both the creation of grading criteria and satisfaction levels and identifcation of critical NSNs.

Wednesday, 1530-1700

Modeling Integrated Logistics Support Operations for "Fighter Wing Equivalents" Through Dynamic Simulation

LTC Stephen R. Parker, U.S. Army Concepts Analysis Agency, and Mr. Patrick M. Williams, BDM Federal, Inc.

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A unique approach is developed for analyzing the balance between supply versus demand in evaluating logistics requirements of the armed forces of the United States. With this approach new ways of measuring combat readiness and logistics support are proposed and available to ensure that the armed forces remain ready to fight during the projected defense draw down beyond the year 2000.

The development of this analysis methodology was established as an alternative approach to answer the never ending question of whether or not the Air Force can maintain logistics to support strategies of force as claimed during the recent Deep Attack Weapons Mix Study (DAWMS).

The contribution of this research is a prescribed method for the strategic analyst to develop an influence diagram which can be used to analyze logistics requirements to project and evaluate force capabilities.

Additionally important to this modeling effort is a prescribed method to evaluate the steady-state logistics flow of fuel and ammunition through time. This will allow the analyst to evaluate various resource strategies, constantly evaluating bottlenecks, and inconsistencies with the logistics flow process. This modeling effort serves as a Simulator to model steady-state logistics flow and as an Output Processor to evaluate and verify TACWAR results.

Use of the Generalized Air Mobility Model (GAMM) in the U.S. Army Ch-47D Sustainment Study

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The GAMM is a detailed simulation of the theater airlift system. GAMM provides detailed information on transportation system effectiveness down to the movement item level of detail, as well as more aggregate measures. GAMM provides analysts with an intratheater mobility analysis capability with associated logistics support and potential for aircraft attrition. The user can model existing or notional airlift requirements. The GAMM can be used to perform sensitivity analyses; that is, by measuring the output results from identical simulations with selected input variations, the influence of individual airlift factors can be observed.

GAMM was developed by General Research Corporation International (GRCI) under contract to the United States Air Force (USAF) for use in the Future Theater Airlift Studies project. This project required a simulation capability for examining operational effectiveness deficiencies in the current USAF theater airlift force and the capabilities offered by notional systems. The U.S. Army, faced

with a similar problem, decided to adapt GAMM to model Army helicopter lift operations.

The current U.S. Army medium lift helicopter (MLH), the CH-47D, is the result of a modernization program in which all CH-47 models were remanufactured after approximately 20 years of operation. This gave what was essentially a new aircraft -- the CH-47D. As this remanufactured fleet reaches 20 years of operational life during the period of fiscal year (FY) 2002 to 2013, the Improved Cargo Helicopter (ICH) program is seen as a means of developing an interim solution to meet the Army's MLH requirements until a replacement (the Joint Transport Rotorcraft) can be fielded around FY 2015.

The GAMM required adaptation before it could serve as a valid way to measure the performance of ICH alternatives under realistic operational conditions. An actual wartime scenario was chosen and logistics requirements for the military forces involved were computed. The job sets for tasks required and the MLH equipment available were loaded into GAMM. The adapted model was then run to give performance results for the various alternatives. These results formed a major part of the analyses that resulted in the determination of the best candidate for the ICH.

Thursday, 0830-1000

Joint Logistics Analysis in Support of DoD Resource Allocation: DAWMS LOG

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The Deep Attack Weapons Mix Study (DAWMS) is a joint study that is attempting to identify the most cost effective mix of weapon systems to support future combat operations. These potential mixes of systems require different types and levels of logistical support to sustain combat operations. This paper presents the methodology and tools that were developed to accomplish logistical analysis for "out-year" systems and concepts. Results of analysis will also be presented, as appropriate.

Optimizing Combatant Ordnance Loadout in Support of Naval Surface Fire Support (NSFS)

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Naval Surface Fire Support (NSFS) has received new attention with the recent military emphasis on regional conflicts and fighting in the littorals.

Delivery of NSFS has been limited primarily to the 5 inch 54 caliber MK 45 gun found on Navy ships. The gun ballistically delivers munitions up to ranges of 10 miles with good accuracy. With some modifications to the gun system and the addition of the new Extended Range Guided Munition round, ranges of 40+ miles can be achieved with guided precision. Also revolutionary in NSFS is the Navy version of the Army Advanced Tactical Missile (NATACM). Launched from Vertical Launch System (VLS), NATACM will introduce a 150+ mile NSFS weapon with GPS guided precision. With these weapons, Navy surface ships can provide round the clock all weather fire support to units formerly dependent on vulnerable shore based artillery or tactical aircraft.

With both new weapons available to a Task Force Commander, the questions of ":how many ships" and "what to bring" will be asked. He must base his loadout on his primary mission and perceived threat, be land attack, air-defense, or anti-ballistic missiles defense. With a finite amount of VLS cells and magazine space, the "what" and "how much" come to the forefront.

This thesis will use stochastic methods and linear programming to answer these questions. The first step involves determining the minimum number of total rounds needed. The objective would be to minimize the number of weapons required based on the cost of the weapons provided the enemy is defeated. The second step would minimize the number of ships required to carry and deliver the determined number of rounds. The objective value would minimize the number of ships based on cost. The final output would be the number and type of ships required and their individual loadout breakdown.

Logistics in JWARS

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The department of defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

Few existing Joint warfare models provide the ability to evaluate a broad spectrum of logistics in balance with the warfighting representations of the model. This presentation will provide a discussion of both the explicit and implicit logistics requirements specified for JWARS. The essential elements of analysis, measures of performance and measures of effectiveness which have be defined to enable the development of the required functionality for JWARS initial operational capability will be provided and discussed. Time permitting, a specific example of ability to evaluate different concepts of combat service support will be addressed

Thursday, 1330-1500

Reducing the Footprint of a Combat Service Support Element

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John J. Bartholdi, III, Professor
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Georgia Institute of Technology

Reducing the footprint of a land-based Combat Service Support Element (CSSE) increases its mobility in battle, but tends to reduce service levels and increase the frequency of replenishments from sea-based assets. We show how to determine which items to assign to the CSSE, and in what quantities, to provide the best level of service with the smallest footprint.
Our method is similar to one used to allocate items to automated material handling systems in a warehouse.

Counter Logistics Through Network Interdiction

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The center of gravity in any campaign can be justifiably argued to be the enemy's logistic tail. History has shown that there can be no long lasting tactical progress without proper logistics. The nature of logistics lends itself to being represented by network graphs. It is the exploitation of these networks that this paper deals with.

The paper is a work in progress Masters Thesis which began 6 Jan 97. The goal is to develop a tool for planners to determine where best to undermine enemy logistics by exploiting the known logistics networks. The purpose is not to develop new algorithms for analyzing networks but to use a library of existing solvers combined with a given data base of enemy networks to determine an enemy's vulnerabilities and to marry the two with a geographic interface. Once all three pieces are brought together , the user will be able to determine not only which node or arc to eliminate, but by how much the elimination of such arcs and nodes will affect the logistics pipeline for a given commodity. As well as finding the optimal arcs and nodes, the program is interactive so that "what if" analysis can be employed by the click of a "mouse" on the nodes(s) or arc(s) in question. The reverse action of determining the optimal allocation of resources to reestablish a damaged network is also addressed. This can be applied to a wide variety of full spectrum operations/MOOTW applications such as peacemaking and enforcement.

The key to the entire project is the fact that the program is written in Java, a new programming language by Sun Microsystems, which can run on a wide variety of hardware platforms and can be loaded dynamically via a network. It is robust, completely object-oriented language that allows programs to work on multiple tasks simultaneously and automatically recycles memory. A Java program can be compiled and stored on a "type A" machine and via an existing computer network can be imported and executed on a "type B" machine. The benefits of this approach include reduced development costs and reduced software support costs.

The Personal Attrition Rate (PAR) Series of Studies: Focus on the Relation Between the Incidence of Psychiatric Casualties and Wounded in Action

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The Personnel Attrition Rate (PAR) series of studies took up many aspects of personnel battle casualties in land combat. These studies will be briefly reviewed to set the context. The remainder of this presentation will focus on psychiatric casualties and their relation to battle stress as represented by wounded in action. Beebe and DeBakey's famous book on Battle Casualties states that "The most uniform and strongest of these relationships [between battle and nonbattle casualties] is the correlation between wounding and psychiatric breakdown in combat troops." This presentation explores some data from army forces in World War I, World War II, and Korea. The aim is to determine whether these data exhibit a consistent relationship of psychiatric casualties to wounded in action for land combat forces.

Thursday, 1530-1700
Air Mobility Express (AMX) Air Force Airlift Requirements

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The Air Force commissioned Dynamics Research Corporation (DRC) to determine the daily airlift requirements in support of the Air Mobility Express concept. The Air Force required this study as a critical input to the Air Mobility Command's refined concept of operations and request for proposal for Air Mobility Express (AMX), an express cargo system to move high value, high priority, small packages from the consignors to a central hub for sorting and subsequent delivery to the theater of operations. DRC's effort was a four-step process: 1) Determine the commodities most likely to be shipped by AMX; 2) Establish daily wartime consumption rates for those core commodities; 3) Compute the daily AMX weight and cube requirements; 4) Conduct capability assessments to determine the impact of AMX on theater aircraft availability. For the purpose of this study, spares eligible for AMX airlift support were significantly broadened to take on a proactive stance in support of a Lean Logistics, Two-level maintenance environment. In this regard we defined warstopper as those reparable and consumable spare parts and aircraft engines whose failure would directly impact the ability to launch an aircraft. We then refined this definition of warstopper into four distinct categories of spare parts that were included in the sizing effort. Using our definitions of warstopper, we computed AMX airlift requirements for three scenarios: Major Regional Contingency (MRC) East, MRC West, and two near-simultaneous MRCs.

WG 27 - MANPOWER AND PERSONNEL – Abstracts
Chair: Herbert J. Shukiar, RAND
Co-Chairs: Maj Tom Garin, SAF/ST
MAJ Douglas Hersh, HQDA ODCSPER
MAJ John P. Johnson, HQDA ODCSPER
Dr. B. J. Wroblewski, OASA (M&RA)
Room: Diamond Hall – CR-2 and MCA Conference Room

Room: Diamond Hall – CR-2

Tuesday, 1030 – 1200

The Air Force Deployment Tasking Report
Capt Rick Hallbeck and Maj David Clement, AFMRF/XR

Stressed Systems Study Phase II
Maj Robert A. Nuanes, AFSAA

Tuesday, 1330-1500

The Personnel Attrition Rate (PAR) Series of Studies: Focus on the Relation Between the Incidence of Psychiatric Casualties and Wounded in Action
Dr. Robert Hlembold, US Army Concepts Analysis Agency

Alternative Models of Navy Enlisted Retention Behavior
Dr. Christopher Mackie and Dr. Patrick Mackin, SAG Corporation

Air Force Pilot Retention: Evaluating the Results of Alternative Econometric Models
Dr. Brice Stone, Kathryn L. Turner, Vincent L. Wiggins, Metrica, Inc, and Larry Looper, Armstrong Laboratory

Wednesday, 0830-1000

US Army Recruiting Command Family of Models
Maj Gregory C. Hoscheit, Ph.D, and Maj Thomas J. Schwartz, US Army Recruiting Command

Army Recruiting Incentives Effectiveness
CPT Christopher M Hill and Claudia Beach, HQ US Army Recruiting Command

Army Measures of Advertising Effectiveness
Maj Michael S. McGurk, US Army Recruiting Command

Contract Cost Effectiveness Proof of Concept Study
Maj William McKinon, US Army Recruiting Command

Wednesday, 1330-1500

COMPOSITE GROUP VI SESSION .... Ellis Hall

Room: MCA Conference Room

Wednesday, 1530-1700

Future Enlisted Management System: An Application of Multiobjective Decision Analysis
Sheila Nataraj Kirby and Harry J. Thie, RAND

An Inventory Projection Model for Civilian Personnel Management
Robert C. Rue, Ph.D, SRA International and John Nestor, Ph.D, Civilian Personnel Management Service

Effect of Future Demographic and Socioeconomic Trends on the Air Force Personnel System
Dr. Brice Stone, Kathryn Turner and Bronwyn H. Salathiel, Metrica, Inc.

Thursday, 0830-1000

QMAN – An Approach to Determining Maintenance Manpower
Capt Richard C Jenkins and William Weaver, Armstrong Laboratory/HRMJ

MaxChoice: The Air Force Officer Classification Algorithm
Capt Mark A. Basalla, HQ AFPC

Information System Design for Sizing Manpower Requirements for Military Operations
Michael L. Davis, SPARTA, Inc

Thursday, 1330-1500
Performance Mesurement Benchmarking Study: A Human Resource Perspective
Maj Thomas A. Garin, SAF/ST

Managing Misconduct: Applying Statistical Control Theory to Sexual Harrassment and other Crimes in the Military
LTC David H. Olwell, Ph.D, USMA

Knowledge Sharing and the Virtual Organization: A US Federal Agency's Approach to Restructuring to Meet 21st Century Challenges
Ms. Leslie Rae, SAIC

Tuesday, 1030-1200
The Air Force Deployment Tasking Report

Capt Rick Hallbeck and Major David Clement
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PERSTEMPO has been a serious topic since DESERT STORM. As the military downsizes there has been an increase in the number of Air Force people deployed world wide. The question is not if one will ever deploy but when. Some major commands and certain functional areas have shouldered the burden more than others. Senior leadership is concerned that heightened PERSTEMPO leads to morale and retention issues. To answer Air Staff concerns the Air Force Manpower Readiness Flight developed the Deployment Tasking Report (DTR). The DTR consolidates all requirements data for joint exercises and contingencies. The DTR is strictly a manpower view based on authorizations and requirements, not assigned or who actually deploys. A summary of the DTR will be presented with an explanation of the data collection process, various report formats available, and actual examples highlighting the inequities among functional areas and commands.

Stressed Systems Study Phase II

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The purpose of this study was to quantify and measure the negative effects of the current OPTEMPO/PERSTEMPO on people and equipment as well as to provide a set of observations and recommendations that mitigate the negative effects of stress. Analysts from Air Force Studies and Analyses (AFSAA) visited over 45 units (operational & support) to collect 33 personnel indicators and 11 equipment indicators of stress. In addition, anecdotal stories, records, and surveys were gathered. Observations were formed for particular units or systems. A spreadsheet model, ôUnitÆs Comprehensive OPTEMPO/PERSTEMPO Estimatorö (UCOPE), was developed and applied to determine: which indicators recorded the highest levels of stress; which unit(s) were the most stressed; and which of the 28 solutions (tailored to the particular unit) would help the stressed unit limit and/or meet taskings. Briefings have been provided to many members of the senior Air Force leadership up to and including the Air Force Chief of Staff. The study, along with the seven observations and six recommendations, have been well received. AFSAA is assisting Air Force Public Affairs in orchestrating maximum exposure of OPTEMPO/PERSTEMPO issues and will be consulting with an integrated process team (IPT) to study the impact of implementing and tailoring some of the solutions prior to a senior Air Force leadership meeting in June and prior to the initiation of *Stressed Systems Study Phase III*.

Tuesday, 1330-1500

The Personnel Attrition Rate (PAR) Series of Studies: Focus on the Relation Between the Incidence of Psychiatric Casualties and Wounded in Action

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The Personnel Attrition Rate (PAR) series of studies took up many aspects of personnel battle casualties in land combat. These studies will be briefly reviewed to set the context.

The remainder of this presentation will focus on psychiatric casualties and their relation to battle stress as represented by wounded in action. Beebe and DeBakeyÆs famous book on Battle Casualties states that ôThe most uniform and strongest of these relationships [between battle and nonbattle casualties] is the correlation between wounding and psychiatric breakdown in combat troops.ö This presentation explores some data from army forces in World War I, World War II, and Korea. The aim is to determine whether these data exhibit a consistent relationship of psychiatric casualties to wounded in action for land combat forces.

Alternative Models of Navy Enlisted Retention Behavior

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The objective of this research is to determine the most appropriate econometric model of Navy enlisted retention behavior. The results will supply parameters used in a number of Navy personnel analysis tools that are designed to quantify the impact of policy changes - including changes in bonus structures, promotion policy, and compensation - on enlistment and reenlistment behavior.

Four structural models of reenlistment behavior are specified - a panel probit, a multinomial probit, a conditional logit, and a nested logit -within the context of a three outcome model in which the choice set equals: (1) leave the Navy, (2) reenlist, or (3) extend. Using all-Navy longitudinal micro data obtained from DMDC, reenlistment/pay elasticities are also calculated.

The Annualized Cost of Leaving (or ACOL) variable is at the center of each model. The ACOL variable captures differences between military earnings and alternative earnings as estimated by a civilian earnings equation. The ACOL includes in its derivation regular military compensation, reenlistment and extension bonuses, military retirement, separation incentives and military promotion.

This research offers an interesting context in which to evaluate relative strengths of various discreet choice modeling techniques. The panel probit allows for explicit control of fixed effects, most notably ôtaste for the military," but cannot accommodate a multi-choice dependent variable. The multinomial probit and conditional logit allow for a multinomial choice set but do not control for fixed effects.

Air Force Pilot Retention: Evaluating the Results of Alternative Econometric Models

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The objective of this study was to explore the relationships between Air Force pilot retention decisions and demographic, educational, economic, and Air Force personnel policy factors. Neural network analysis was used to provide key insights into explanatory variable nonlinearities and interactions that were incorporated into a nonlinear logit model whose parameters were estimated using individual, pilot, Air Force, institutional, and economic data from 1980 to 1988. The in-sample nonlinear logit results showed over 82

percent (46 of 56) of the explanatory variables specified in the nonlinear logit equation to be significant. The nonlinear logit and a logit model without the nonlinear and interaction variables were then used to predict pilot continuation during the first three years (1989 - 1991) of the pilot retention bonus. Results of the out of sample using both logit models showed them to be valid and capable of tracking the continuation behavior of individual pilots as well as pilot groups aggregated by grade and years of service, although, the nonlinear model did slightly outperform the linear model. An examination of explanatory variable elasticities derived from the nonlinear logit model demonstrated clearly the efficacy of the pilot bonus as an effective personnel management tool. Prior to the implementation of the bonus, the continuation behavior of Air Force pilots tended to be rather inelastic, especially as related to relative military to civilian compensation (elasticity = .529). After the bonus was in place, the elasticity of relative compensation increased dramatically to 2.335, indicating that pilot retention behavior had moved to an area of the response function where small changes in relative compensation could have significant effects on force retention. A key conclusion, based upon these results, is that elimination or reduction of the bonus could have serious negative effects on future pilot manning levels, given expected levels of airline hiring and force manning.

Wednesday, 0830-1000

U.S. Army Recruiting Command Family of Models

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The U.S. Army Recruiting Command's (USAREC) primary mission is to locate, contract and access quality recruits into the Army. Each year USAREC receives an accession mission from DOD and must then distribute this mission throughout the year to the five subordinate Recruiting Brigades with recommendations for the 41 Recruiting Battalions. Each battalion is unique, representing many different regional cross sectional segments of society and regional cultural identities. Additionally over 5300 recruiters have to be distributed across the country to cover the many different markets. To assist the Commanding General in this effort, the Program Analysis and Evaluation (PAE) directorate has developed a family of models which help distribute the mission and recruiters. The Command Level Mission Model (CLEMM) uses dynamic regression to distribute the mission and the Recruiter Allocation Model (RAM) uses a multi-attribute weighted average approach to allocate the recruiters. Finally PAE is developing a simulation model of the recruiting process to aid the Command Group in quantifying the performance of the entire recruiting system and performing up front analysis of proposed policy changes, such as changing incentive programs. This presentation will discuss these models and their interrelationships.

Army Recruiting Incentives Effectiveness

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Approved abstract not available at printing.

Army Measures of Advertising Effectiveness

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The days of large budgets and abundant resources are over. In the recruiting community one of the most difficult areas to accurately measure is Advertising Effectiveness. The United States Army Recruiting Command spends over $60 million per year on advertising, media and direct mail. The Advertising Research Branch, Program Analysis and Evaluation Directorate, is tasked to examine the effectiveness of Army advertising. In 1995 the Army launched a "Rebranding" campaign with the stated goal of elevating the perception of Army service and the soldiers who have joined the Army. This study examines the increase in Army advertising to determine if the increased budgets resulted in (1) an increase in national awareness among the target population, as measured by the number and percentage of leads generated, and (2) an increase on the reported influence on new recruits, as measured by the Army New Recruit Survey. To provide a comprehensive analysis of the effects of advertising expenditures, this study investigates national advertising by media type, e.g.

television, radio, print and direct marketing, and the number of leads generated, as measured by the national leads center. Enlistments are not an accurate measure of advertising as it deals with the sales process as well. Leads may be as close to a true measure as we can get. Discussion of the complexity of quantitative measures to a qualitative product will also be addressed.

Contract Cost Effectiveness Proof of Concept Study

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In 1994 Congress requested that the General Accounting Office (GAO) conduct a study of military recruiting to determine where costs could be cut without a negative impact on the recruiting mission. Recruiting facilities became a significant aspect of this study. After reviewing the GAO findings, Congress asked the Secretary of Defense to conduct a study to determine the feasibility of using a joint process to determine the location and manning of recruiting stations. In April 1996 OSD Accession Policy convened a joint service task force to examine this issue. The task force determined that, as a preliminary step, a common contract cost effectiveness methodology would be required. The Army, specifically US Army Recruiting Command, received the mission to develop a contract cost effectiveness model that could be applied by all services. The resulting model, developed in the Fall of 1996, incorporates a variety of manning, production and cost data. It rank orders all recruiting stations within urban, suburban and rural classifications. Fiscal Year 1995 data was used for the study. This presentation will discuss the data, the spreadsheet model used to organize it and the preliminary results achieved.

Wednesday, 1330-1500
COMPOSITE GROUP VI SESSION

Wednesday, 1530-1700
Future Enlisted Management System: An Application of Multiobjective Decision Analysis

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The enlisted force will be called upon to face new challenges and new missions in the future. It is important to assess whether the current management system will be adequate for managing the enlisted force in the future in a way that best meets the country's national military objectives. As part of this assessment, we need to understand what the objectives of such a management system should be, what alternatives are available to meet these objectives, and how best to reconcile competing objectives. This needs to be done in a structured framework that allows one to fully consider the tradeoffs among these objectives. Multiobjective decision analysis provides such a framework and a means to incorporate the information, opinions, and preferences of the various relevant players into the decision making process. This paper employs this methodology to address the issue of future enlisted management systems, to highlight the differing outcomes of various alternatives, and to underscore the value of approaching such issues in a strategic manner.

An Inventory Projection Model for Civilian Personnel Management

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The Civilian Personnel Management Service (CPMS) has developed a simulation model to support DASD(P&R) (Civilian Personnel Policy) in the development and analysis of civilian personnel management policies. The model simulates the following civilian lifecycle processes: accession, development, utilization, sustainment, and separation and retirement. The simulation model is written in SIMSCRIPT for a Sun SparcStation or HP-UX computer. Input data for the simulation are developed from Defense Manpower Data Center files using the Statistical Analysis System (SAS) code. Input data are stored in an Access database and Access utilities are provided to select subsets of the data for a given run of the model. The presentation will describe the development effort and the capabilities of the model.

Effect of Future Demographic and Socioeconomic Trends on the Air Force Personnel System

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The objective of this project was to develop a methodology for projecting the demographic characteristics of the Air Force enlisted and officer corps through the year 2025. The characteristics considered were gender, age, sex, race, ethnic group, Armed Services Vocational Aptitude Battery (ASVAB), Armed Forces Qualifying Test (AFQT), Armed Forces Officer Qualifying Test (AFOQT), Mechanical, Administrative, General, and Electronic (MAGE) composites, success/failure in Basic Military Training or officer training, physical and strength characteristics and capacity, education level upon entry and upon leaving, source of commission, and entry Air Force Specialty (AFS) as well as subsequent AFS. A review of past and present methodologies for socioeconomic , population and force projections was conducted. The Bureau of Census projections were chosen as the primary source for population data. The population was filtered through three levels of possible accessions. These are military available(MA), qualified military available (QMA) and interested qualified military available (IQMA), in that order. Key factors were identified as critical to the development of a future force that will mirror society. As the minority groups grow to be a larger portion of society, the number of high school graduates available to the force may shrink significantly. At the same time, the average mechanical score is projected to continue to fall. If these factors are combined with a low population growth rate and significantly decreased propensity for youth to enter the armed forces, recruiting difficulties could intensify to a critical level.

<u>*Thursday, 0830-1000*</u>
QMAN - An Approach to Determining Maintenance Manpower

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The Queuing Manpower Model (QMAN) was developed to quickly and accurately calculate the number of personnel required to perform aircraft/equipment maintenance in support of aircraft sortie generation. Data used by the model is based on historical aircraft equipment failure rates and maintenance workload. QMAN determines the minimum number of personnel in each Occupational Specialty (OS) needed to sustain a specific aircraft sortie generation rate by applying three different manpower determination algorithms: a queuing-theory algorithm, a utilization adjusted workload algorithm, and a minimum crew size algorithm. The actual maintenance manpower requirement in each OS is the largest of these three values. The Turbo Pascal coded implementation of QMAN has been validated against the Air Force standard maintenance model, the Logistics Composite Model (LCOM).

In addition to quickly and accurately determining maintenance manpower requirements, another use for QMAN is as a front end estimator of manpower resource inputs for discrete-event Monte Carlo simulations such as LCOM. Using QMAN manpower estimates as input seed values to LCOM can reduce by 75 percent the complex constraining process required to determine minimum manpower requirements. Additionally, QMAN can provide quick answers to analysis that would otherwise require extensive simulation run times. Examples of such analysis include the impact on manpower requirements of increased maintainer productivity, variable work shifts and flying requirements, and alternative maintenance occupational specialty structures.

MaxChoice: The Air Force Officer Classification Algorithm

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Every new 2nd Lieutenant entering the Air Force needs to be classified into one of the Air Force Specialty Codes (AFSC). This AFSC defines the type of job that the new officer will have. The current mode of classification is one where two people manually read the candidatesÆ records and sequentially assign them one of 45 possible AFSCs. They try to give each person his highest choice as possible. However, there is no attempt to optimize the solution for either the Air Force or the person.

MaxChoice is an expert system that automatically formulates the problem as an Integer Program (IP). The inputs include: seven AFSC choices from the "dream sheet," degree type, GPA, and class ranking. MaxChoice reads in a dataset containing each of these variables for each new lieutenant. MaxChoice reads in another dataset that contains the accession targets for each of the particular career fields. The computer routine then builds the objective function and a series of constraints for the IP. There is a binary structural variable for each new lieutenant for each AFSC. There is a constraint for each lieutenant which makes sure that everyone is assigned an AFSC. There is also a constraint for each AFSC that makes sure that the defined target is filled. This formulated IP is then solved using the LP procedure in the SAS/OR software package.

MaxChoice is written in SAS NT 6.11. It is run on a P5-100 PC, with 32 MB RAM, using the Windows NT 4.0 operating system. It takes approximately 12 minutes to classify 1000 lieutenants.

Information System Design for Sizing Manpower Requirements for Military Operations

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It is imperative, in the current environment of force downsizing, to utilize all information and tools available to determine manpower requirements. This paper discusses a methodology for locating all needed information and tools in a PC-based environment. SPARTA currently uses two primary analysis tools in developing manpower requirements. The Total Operating and Support Analysis Model (TOPSAM) assesses Operating and Support (O&S) requirements by identifying the manpower and the associated O&S costs for an organization. TOPSAM addresses personnel at the Military Occupational Specialty and grade level in individual paragraphs of a Table of Organization and Equipment. The equipment hardware work breakdown structure is addressed at the Line Item Number level. The Logistics Analysis Model (LOGAM) assesses the system peculiar equipment at the lowest hardware indenture and determines logistics support requirements for the modeled system.

SPARTA has successfully demonstrated the use of a single computer screen to control the use of several PC based models, spreadsheets and word processing programs. This allows the creation of analysis and planning products for logistics, cost, reliability, maintainability, and acquisition from multiple sources. This infrastructure automates the development process, provides quicker turn around times, facilitates information distribution and reduces costs associated with performing analysis and documentation.

Thursday, 1330-1500
Performance Measurement Benchmarking Study: A Human Resource Perspective

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This prresentation highlights work we did as part of the Federal Benchmarking Consortium Performance Measurement Study, sponsored by the National Performance Review, to investigate and report on how leading organizations measure their performance, focusing on the development and the use of performance measures. Next, it summarizes how a federal government agency can apply lessons learned to the human resource function.

Managing Misconduct: Applying Statistical Control Theory to Sexual Harassment and other Crimes in the Military.

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Occurrences of sexual harassment, suicide, and other crimes in the military can be modeled as Poisson processes. We are interested in estimating the parameter of the process, understanding usual variation under this model, and quickly detecting model departures. We are particularly interested in applying these methods quickly when extensive historical data is not available or no longer valid.

This paper develops control charts based on the predictive Poisson distribution and applies them to misconduct incident data. There is one chart to detect isolated large departures and a second to detect small persistent changes. A third updates the posterior distribution for the occurrence rate. The control charts learn from the data, and increase in precision as more data is obtained.

The charts allow prompt detection and correction of circumstances leading to increases (or decreases) in the occurrence rate. Conventional methods require 25 to 30 periods to estimate parameters; these methods do not. This is advantageous for re-establishing control after a shock to the system, such as the Aberdeen scandal, which invalidates previous estimates of the rates. By understanding the expected variation under this model, one can save resources by not over-reacting to usual variation.

The methods of this paper are original. They have been implemented using a Quattro Pro spreadsheet, for ease of dissemination in the OR community. We illustrate the methods with two data sets.

Knowledge Sharing and the Virtual Organization: A U.S. Federal Agency's Approach to Restructuring to Meet 21st Century Challenges

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As organizations -- governments, industry, and academia -- move into the seamless, boundary-less 21st century, the value-added of individuals who are part of these organizations will be measured by their ability to share knowledge and expertise with others. Given the complexity and dynamics of the 21st century, if individuals cannot -- or will not -- share knowledge their value to organizations will be limited.

Much of knowledge sharing is cultural, and a very small part is technical. To this end, knowledge sharing is leadership-driven and technology-enabled. The goal is to create an environment where communication among knowledge workers can be accomplished across the traditional boundaries of time and space. The value of technology-enabled communication includes the ability to develop an organizational memory, rather than isolated pockets of expertise. The synergy of collaborative relationships produces a larger "whole" than mere aggregation of individual contributions.

This presentation will describe the complexity of how an organization makes this cultural shift. Last year, several organizations within the U.S. Department of Energy (DOE) began sharing technical personnel on a DOE Complex-wide basis. In addition, these traditionally isolated DOE sites began exchanging technical knowledge and expertise.

The goal of this effort was to enhance DOE's ability to maintain and even strengthen the Agency's technical capability; and to break down the compartmentalization, isolation, and redundancy built into the DOE Complex during the Cold War. Overall, was the desire to enhance technical experience, expertise, and productivity through cross-functional synergy.

The DOE knowledge sharing program began in the spring of 1996 in the face of mounting Congressional pressure to reduce the Agency's budget and changing missions. The concern among DOE leaders was that budget reductions -- while striving to make DOE more efficient -- would at the same time undermine the Agency's ability to meet enduring research and technical requirements of DOE programs.

This presentation focuses on the development of a knowledge sharing network from both a technical and organizational perspective; the underlying design principles behind creating such an organization; and the learning experiences to include transition from a design phase to an operational phase.

WG 28 – RESOURCE ANALYSIS & FORECASTING – Agenda

Chair: LCDR Timothy P. Anderson, Naval Center for Cost Analysis
Co-chair: Dr. Bruce MacDonald, MCR Federal, Inc.
Co-chair: Mr. Steve Malashevitz, Air Force Institute of Technology
Advisor: Dr. Thomas Frazier, Institute for Defense Analysis
Room: MCRC – CR-134 and CR-166

Room: MCRC – CR-134

Tuesday, 1030-1200
An Overview of Issues and Current Practices in Cost Uncertainty Analysis
Dr. Henry L. Eskew, Center for Naval Analyses

Panel Discussion on Cost Estimating Tools and Methods
Dr. Gerald McNichols, MCR Federal, Inc.
Prof. Rolf Clark, Industrial College of the Armed Forces
Mr. Jack Graser, Associate Deputy Undersecretary of the Air Force for Cost and Economics

Tuesday, 1330-1500
The New Navy VAMOSC
CDR Walt Bednarski, Naval Center for Cost Analysis

"Cost of a Sailor"
Mr. Leonard Cheshire, Naval Center for Cost Analysis

Software Development Cost Estimating Research
Ms. Cheri Cummings, CDR Barbara Marsh-Jones, Ms. Pamela Johnson, Ms. Jill Von Kuegelgen, Naval Center for Cost Analysis

Wednesday, 0830-1000
Discount Rates for Government Investment Projects: The Economic Logic Behind OMB Circular A-94
Dr. Matthew S. Goldberg, Institute for Defense Analysis

SC-21 Sonar Performance Based Cost Model - A CAIV Effort
Mr. James Keller, Naval Center for Cost Analysis

Practical and Theoretical Considerations When Integrating LP and Multi-Attribute Theory: Lessons Learned in Large Scale Applications
LTC Daniel T. Maxwell, LTC Roger Pudwill, Ms. Linda Coblentz, U. S. Army Concepts Analysis Agency

Wednesday, 1330-1500
COMPOSITE GROUP VI SESSION .... Ellis Hall

Room: MCRC – CR-166

Wednesday, 1530-1700
Battle Cost: A Tool for Determining the Level of Investment in System Protection
Mr. William A. Hockberger, Consultant

The Causes of Growth in Operating & Support Spending
Mr. Stan Horowitz, Institute for Defense Analysis

Privatization Cost/Benefit Analysis for the Naval Air Warfare Center - Aircraft Division, Indianapolis, IN
Dr. Bruce MacDonald, MCR Federal, Inc.

Thursday, 0830-1000
Justifying "Management Reserve" Requests by Allocating "Risk Dollars" among Project Elements
Dr. Stephen A. Book, The Aerospace Corporation

Why Correlation Matters in Cost Estimating
Dr. Stephen A. Book, The Aerospace Corporation

A Management Tool for Prioritizing, Displaying, and Tracking Program Risk
Dr. Paul Garvey, The MITRE Corporation

Thursday, 1330-1500
Quantitative COTS Software Costing Process
Mr. Bryan Piggott, PRC, Inc.

Defense Program Projection (DPP) - Robust Analysis for Extended Planning
Mr. Philip A. Richard, GRCI and Dr. Will Jarvis, OD (PA&E)

Thursday, 1530-1700
Managing Research in Environmental Decision Making (MRED)
Mr. James J. Connelly, U. S. Army Concepts Analysis Agency

Rapid Cost Analysis to Complex/Uncertain Environmental Regulations Development
MAJ Patrick J. DuBois, Ph.D., U. S. Army Concepts Analysis Agency

Quality Function Deployment as a Tool for Implementing CAIV
Mr. David Wollover, SPARTA

WG 28 - RESOURCE ANALYSIS & FORECASTING - Abstracts

Tuesday, 1030-1200
An Overview of Cost-Risk Analysis

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This presentation focuses on selected analytical procedures and software packages associated with cost uncertainty analysis. The analytical questions have to do with (1) treatment of correlation among cost elements, (2) selection of specific probability distributions for characterizing uncertainty in different circumstances, and (3) generation of parameter values for the distributions. Features of software packages that support risk/uncertainty analysis are also discussed.

Panel Discussion on Cost Estimating Tools and Methodologies: Current Capabilities and Future Requirements

Dr. Gerald McNichols, MCR
Prof. Rolf Clark, Industrial College of the Armed Forces
Jack Graser, Associate Deputy Undersecretary of the Air Force for Cost and Economics
Bruce MacDonald, Moderator
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This panel discussion will bring together recognized authorities in cost and resource analysis from the consultant, academic, military and civilian government communities. The panel will begin by discussing the state of the art in cost estimating tools and methodologies, identifying how current applications have influenced national defense decision makers. Panel members will also look to the future, identifying areas where progress needs to be made in the tools available to the practitioner as well as in the way the tools are used. Comments and questions from the audience will be encouraged throughout the discussion.

Tuesday, 1330-1500
The New Navy VAMOSC

CDR Walter S. Bednarski, USN, Navy VAMOSC Program Manager
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This presentation will describe the status of the conversion of the Navy Visibility and Management of Operating & Support Costs (VAMOSC) flat-file database to a relational database to improve and expand access to historical Navy operating & support costs. An on-line demonstration of the New Navy VAMOSC application will be presented. A delineation of the functional requirements to capture the Total Ownership Costs of Navy weapon systems will be identified. The improvements are intended to make the system more complete, more timely, and more accessible to users throughout DoD and industry.

The VAMOSC database contains operating & support costs incurred over the last 18 years for Navy ships and over the last eight years for Navy and Marine Corps aircraft. Detailed maintenance data can be presented at the Equipment Identification Code/ Expanded Ship Work Breakdown Structure code level for ships and at the Work Unit Code level for aircraft. Recent additions to the VAMOSC database include costs incurred by missiles and torpedoes, selected automated information systems, and ships operated by the Military Sealift Command. The New Navy VAMOSC application and Database is accessible via the Internet, and provides expanded and On-Line Analysis Program (OLAP) capability to assist end users.

"Cost of a Sailor"

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The Naval Center for Cost Analysis (NCCA) conducted a study to determine more accurate manpower cost estimating rates than those currently in use. In the past, manpower cost estimating rates have included only direct personnel costs. There is a need to address indirect personnel costs as well, and more specifically, to distinguish between fixed and variable indirect costs. The ultimate objective of this study is to develop a detailed model for estimating the total cost impact on the Navy - direct and indirect - occasioned by increases or decreases in operating force personnel.

The fundamental approach to determining the cost of a sailor is the identification of certain Navy billets, called indirect billets, that provide personnel support to other billets. Billets that provide support to Naval forces, i.e., ships, aircraft and hardware, are not considered support to Naval personnel, and are therefore not part of indirect personnel costs.

There is no single methodology or set of manpower rates that are appropriate for estimating personnel costs for all purposes. For example, for PPBS purposes the cost estimator will be interested in rates that cover MPN only. However, for determining the overall cost impact to the Navy, manpower rates that include the cost of the personnel support tail should be used. The "Cost of A Sailor" rates, which include direct manpower costs and variable indirect manpower costs, are appropriate for life cycle cost estimates used in the Analysis of Alternatives process, for Milestone Decisions, and for special tradeoff studies.

The Naval Center for Cost Analysis' Software Development Estimating Research

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When the Naval Center for Cost Analysis (NCCA) organized a software team to assess NCCA's software cost estimating processes, it was discovered that NCCA did not have a well-defined and consistent process for estimating software cost. Based on a survey of 25 governmental agencies and contractors, it was apparent that other organizations experienced similar problems; thus, NCCA began an extensive research effort to improve in-house software cost estimating capabilities.

NCCA established three phases of the software research effort: Level One, Level Two, and Level Three. Level One is the baseline software development cost research effort discussed in this paper. The Level One goals are to provide a centralized and documented database of available governmental software databases, formal procedures and guidelines, top-level software cost estimating tools, and training in the proper use of Level One tools.

After compiling and normalizing the databases to support the software cost estimating research, NCCA conducted a detailed analysis of each database to develop standard tools for estimating effort, schedule, cost, and risk (SLOC growth and code condition change) that would be credible, reproducible, defensible and well documented. These cost estimating tools, with associated documentation including methodology, results, strengths, weaknesses and future efforts, are detailed in this paper.

Since the databases for effort, schedule, and risk are from older and typically non-contractor specific databases, the coefficients of variation (CVs) of the resulting regressions and tools are typically higher than 30 percent. Although the resulting man-year rate estimating tools experienced much tighter variances, the size of the database is a concern. NCCA realizes that the lack of current and contractor-specific software data lessens the quality of the tools developed; however, NCCA views this effort as a solid foundation upon which improved software cost estimating can commence. In the future, through the use of NCCA's in-house software data collection forms and more informed analysts, NCCA intends to strengthen this analysis.

Wednesday, 0830-1000
Discount Rates For Government Investment Projects: The Economic Logic Behind OMB Circular A-94

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This presentation examines OMB Circular A-94, which requires that costs and benefits of government programs be discounted at the Treasury borrowing rate on bonds of maturity equal to the period of analysis. It is shown that, in a two-period problem, discounting at the Treasury rate always leads to the correct investment decision; i.e., the winning project may be transformed, via market transactions, into one that dominates the losing project. Discounting at the Treasury rate may lead to some anomalies when evaluating projects of longer duration, but these anomalies are probably not important empirically. Finally, it is shown that the dominating project may be computed using linear programming.

SC-21 Sonar Performance Based Cost Model - A CAIV Effort

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This presentation will describe the rationale for and approach to building a cost-performance tradeoff model for shipboard sonar systems. The approach utilizes nonlinear mathematical programming to integrate deterministic engineering design equations with stochastic regression relationships, and may be appropriate for a wide range of weapon systems. In essence, it is a mathematically constructed feasible solution space of cost, performance, and technical parameters. By constraining one or more variables (e.g., cost, range), the possible values of all other variables become tightly bounded (e.g., resolution, power). In this way, trade studies are easily performed and risk and uncertainty is statistically quantified. Additionally, this model easily incorporates process relationships as well. This versatility makes PBCM a powerful, general use statistical and constraint management tool.

Practical and Theoretical Considerations When Integrating Linear Programming and Multi-Attribute Utility Theory: Lessons Learned in Large Scale Applications

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Significant advances in the computer and computational sciences are allowing analysts to address increasingly complex problems. As these advances are applied to the complex problems faced by governmental and industrial leaders, the demand for ever-increasing levels of complexity in computer-based modeling and analysis also increases. Many of the problems faced by these leaders are characterized by both large combinations of alternative solutions and multiple, often competing objectives. Linear programming and decision analysis are two mathematical modeling tools that are designed to address these types of problems. Analysis reports and software tools are emerging that are beginning to integrate these techniques. However, each of the techniques have properties that must be considered if they are to provide a meaningful integrated model. We describe a multi-billion dollar resource allocation problem that has benefited from such analysis. We outline the principal axioms of each technique and properties that must be preserved as the model is desegregated and reassembled for integrated analysis. Finally, we address some practical considerations that are highly useful in communicating analysis results to clients.

Wednesday, 1330-1500
COMPOSITE GROUP VI SESSION

Wednesday, 1530-1700
Battle Cost: A Tool for Determining the Level of Investment in System Protection

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Battle costs are defined in this paper as the hypothetical future costs that may be incurred by a system as a result of engaging in battle. They include both the costs of weapons and materiel expended and the costs of damage and destruction sustained by the system. Using naval ships as an example, the paper discusses how those hypothetical future costs can be estimated and traded off against the real costs of investing initially in protective capabilities to avoid or reduce them. How to consider human casualties is also addressed.

The Causes of Growth in Operating & Support Spending

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While force structure and the number of personnel in uniform have fallen dramatically, DOD's operating and support costs were higher in 1995 than they were in 1975. This paper examines the reasons for this phenomenon. First, corrections must be made for the changes in accounting practices over the twenty year period, otherwise it would be impossible to make consistent comparisons. Then, we examine whether the direct cost of operating forces has become more expensive or whether cost growth has been concentrated in parts of the defense infrastructure. The costs of operating successive generations of selected equipments are compared. Finally, operating costs are compared with the capability for several categories of equipment. We find that:

- the growth in O&S costs is concentrated in O&M;
- the growth in O&M is largely related to infrastructure costs;
- new systems do not cost much more to operate than their predecessors, with the exception of Army systems;
- O&S costs per unit of capability appear to be falling.

Privatization Cost/Benefit Analysis for the Naval Air Warfare Center - Aircraft Division, Indianapolis, IN

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The 1995 Base Realignment and Closure (BRAC) Commission reviewed operations at the Naval Air Warfare Center Indianapolis (NAWC-ADI) and recommended it be closed with portions begin relocated to other Navy activities. The City of Indianapolis, concerned over the negative impact that the NAWC-ADI closure might have on the local community, proposed a public-private partnership as an alternative reuse of the facility. The Navy requested that MCR, Inc conduct a Cost/Benefit Analysis (C/BA) to identify the cost and benefits of each option. The results of the study were used by Commander, Naval Air Systems Command and other senior Navy decision makers in determining which BRAC Commission recommendation to implement.

The scope of the CBA included both quantitative (costs, savings) and qualitative attributes of both the Navy plan and privatization. In general, the analysis was limited to a comparison of

- Advantages of each alternative
- Recurring workload costs for the length of the privatization contract (5 years)
- Implementation costs (non-recurring)
- Federal government savings under each alternative

The study results indicated that net savings in then-year dollars over five years favor privatization; while savings at the ten year point do not significantly favor either alternative. Internal Rate of Return and Net Present Value calculations also support privatization in place.

Thursday, 0830-1000

Justifying "Management Reserve" Requests by Allocating "Risk Dollars" among Project Elements

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Asymmetry in the probable magnitude of the difference between actual project cost and the so-called "best estimate" often leads common estimating methods such as "rolling up" (i.e., adding) most likely costs of the various project elements to underestimate actual project cost. Because of the uncertainty in actual cost, it is useful to express cost estimates in terms of percentiles of its probability distribution. After a project is finally budgeted at its best-estimate cost, it is prudent to prepare a "management reserve" of additional funds to overcome unanticipated contingencies that may deplete the budget prior to project completion. Percentiles of the cost probability distribution can serve as guidelines for the size of an appropriate management reserve. Suppose, for example, that the best estimate falls at the 40th percentile level of the cost probability distribution. Depending on the criticality of the project, a prudent management reserve might consist of the funds required to bring the total amount of available dollars to the 50th, 70th, or even 90th percentile. Dollars in the management reserve pool, referred to as "risk dollars," may in some cases constitute a noticeably large percentage of the budgeted best-estimate funding base. Because those providing funding often consider management reserves to be slightly below "slush finds" on the decency scale, it is necessary to provide logical justification by displaying an allocation of risk dollars in a defendable way among the various project elements. The present report suggests a mathematical procedure that will allow the analyst to allocate risk dollars among the project elements in a manner consistent with the original goals of the cost-estimating task.

Why Correlation Matters in Cost Estimating

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Cost-risk analysis calls for modeling costs of work breakdown structure (WBS) elements as random variables. Costs of particular WBS elements may be pairwise correlated in the sense that actions taken to resolve uncertainty in the cost of one element may influence the ultimate cost of another element. Because of its impact on the standard deviation (sigma value) of the total-cost probability distribution, correlation between risks of different WBS elements is an important consideration in summing WBS-element costs statistically to compute the distribution of total cost. While it may be difficult or even impossible to justify use of a specific numerical value to represent the extent of correlation between two WBS-element costs, it is important to avoid the thought trap that says, "Because we cannot establish a precise value for the correlation, we'd better leave it out altogether and proceed without it." While it may appear at first glance that we can thereby avoid the problem of not being able to specify the correlation precisely, we will be in fact making a hard decision that the correlation is zero. However, because positive values of the correlation coefficient tend to widen the total-cost probability distribution and therefore increase the gap between the 70th-percentile cost and the best-estimate cost, the present report makes a credible case for using appropriate positive or negative values such as 0.3, for example, instead of 0.0 in most cases, because their use will lead to a more realistic representation of the total-cost distribution.

A Management Tool for Prioritizing, Displaying, and Tracking Program Risk

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This work presents a family of preference models for prioritizing risk. These models originate from multiattribute utility theory and rank-order project-defined risk events as a function of multiple criteria. Such criteria includes, but is not limited to, a program's cost, schedule, and technical performance. In addition, the methodology is tuned for quantifying the effects of coupled (dependent) risks. As a decision-aid, these models target where engineering assests are best applied to mitigate potentially crippling areas of risk to a program.

Thursday, 1330-1500
Quantitative COTS Software Costing Process

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The PRC Quantitative COTS Costing Process (QCCP) is part of the PRC Software Engineering Methodology, and extends our trade study process with the added dimensions of product utility versus integration cost. PRC applies the unique Quantitative COTS Costing Process to assess up-front the utility of and the cost for integrating a COTS package into an operational environment; this enables adjudging cost versus capabilities at the outset of the life cycle, and the refinement of the assessments as the process continues. A separate model is being developed to assess life cycle costs. This process has several features and benefits:

- Our model revolves around the use of recognized costing tools such as COCOMO, whose mathematics are in the public domain, and is the most common model used for this purpose.
- Because of the linkage to accepted tools like COCOMO and Function Point Analysis, QCCP is easy to understand and use.
- QCCP provides a means to balance cost against capability since it examines three elements key to selecting and using a COTS product: satisfaction of functional/user requirements, ease of integration, and product quality.
- It provides the means to determine the initial cost of integrating the product into a system. Results are repeatable since the method is based upon documented formulae and models.
- Allows for "what-if" analysis to suggest to the vendor modifications to the COTS product to increase functional coverage, improve integration features, enhance quality, i.e., it provides a means to leverage vendors to provide product improvement.
- QCCP provides a measure for return on investment and supports judgments to eliminate COTS that lack capability or that would be too costly to integrate.

Defense Program Projection (DPP) - Robust Analysis for Extended Planning

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The Defense Program Projection is a long-term projection of DOD programs based on the President's Budget FYDP and other official documents. It is the joint venture of OD PA&E and USD(A) API to meet Defense Management Review requirement for:

> " ... a rough, 20-year "road map" of the modernization needs and investment plans of DOD, projecting the impact of the Program Planning Objectives, and of additional modernization or replacement of major systems (e.g., ships, aircraft, tanks and satellites) expected by the Military Departments and Defense Agencies, against realistic levels of future funding."

The DPP effort results in a projection of the Future Years Defense Plan (FYDP) database twelve years beyond the end of the FYDP, currently out to FY2015. Inputs to this analysis include the FYDP, analyst projections of the force structure, investment projections based on current Service plans, as well as OD PA&E and USD(A) API projections of the consequences of those plans. The DPP includes high and low excursions as well as an analysis and characterization of the budget, policy, and affordability risk inherent in the projection. DPP data and analyses have been used in the past in supporting the Bottom Up Review (BUR) and will be used in the Quadrennial Defense Review.

The DPP study effort uses several measures of merit to determine investment adequacy and program supportability. These measures include average fleet age, age distribution, steady state procurement, affordability, and force modernization rate. A major portion of the DPP presentation to high level DOD officials consists of highlighting the extent to which Service investment programs comply with these PA&E determined goals.

This presentation focuses on the process of determining, analyzing, and reporting investment program compliance with program goals.

Thursday, 1530-1700
Managing Research in Environmental Decision-Making (MRED)

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Economic benefits were required for each of 60 Army R&D project proposals submitted for funding under the DOD Environmental Security Technology Certification program for FY 97. An ad hoc analysis was conducted using a methodology based upon recently developed cost factors for each of 122 services provided at Army installations. The proposal savings were expressed as impacts (+/-) on those services. The proposal impact data was collected using a field survey of proposal principals, who selected the areas of impact, assessed the project impact, as a simple percentage impact on the service area, and whether this impact increased (+) or decreased (-) the area cost. The analysis then applied the percentage impact to the pre-determined cost factor for the service to convert it to a service dollar impact (+/-). The individual service dollar impacts were then summed algebraically to arrive at a net service cost impact. The proposal economic benefits, in the form of payback and net present value, were then ranked (separately) to meet the sponsor requirement for a consistent set of prioritized economic benefit values.

Refinements to the methodology are under consideration, including use of a metric service value from which the service percentage could be computed rather than estimated, and automation of the overall process to provide consistency and documentation of the analysis. This automated process could expedite the analysis of economic benefits for the extensive set of environmental projects documented in the Army Environmental Program Requirement Report.

Rapid Cost Analysis to Complex/Uncertain Environmental Regulation Development

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Clients or sponsors desiring the cost impact of developing environmental regulations are notorious for wanting results before complex and politically sensitive (uncertain) environmental regulations are complete. A solution to the dilemma is the development of a user-friendly, interactive spreadsheet with @RISK Add-In that allows the user (analyst, client or sponsor) to create "what-if" scenarios that automatically calculate the corresponding cost of the scenario. In a key environmental initiative, the US Army is working side-by-side with State of Utah environmental regulators to develop a Land Disposal Restrictions (LDR) rule to regulate the land disposal of hazardous waste in the State of Utah. During the development of the rule, the Army and the State were constantly requesting the cost impacts of key initiatives (LDR levels, exit levels) of the rule. In order to keep up with the rapid changes in key initiatives, a user-friendly, interactive spreadsheet was developed using the following steps: (1) develop flowchart to model the path of common waste streams; (2) develop survey sheet by entering decision node questions from flowchart into column headings and waste stream names into row headings; (3) enter appropriate waste quantity and cost data into separate sheets; (4) combine the data from the sheets (cost, quantity and survey) with multiple "IF" statements and formulae in a cost analysis sheet to obtain the cost impact of the initiative. Hence, the analyst of the client/sponsor obtains instantaneous, accurate cost feedback.

WG29 – READINESS - Agenda

Chair: Jack Leather, Defense Manpower Data Center/TREAD
Cochair: Mike Wagner, Dynamics Research Corporation
Cochair: Linda Bors, USSTRATCOM/J612
Cochair: Scott Flood, Chief of Naval Operations (N814)
Cochair: Duane Pace, Defense Manpower Data Center/TREAD
Advisor: Joesph Angello, ODUSD(R)(RP&A)
Room: MCRC – CR-227

Room: MCRC – CR-227

Tuesday, 1030-1200
Advisor Opening Remarks
Mr. Joseph Angello, ODUSD(R)(RP&A)

FYDP-Based Readiness O&M Macroanalysis
Col Charley Mitchell, USA, ODUSD(R)(RP&A)

Funding and Readiness
Dr. Stan Horowitz, Institute for Defense Analyses

Tuesday, 1330-1500
Readiness Assessment Systems
CDR Charlie Hautau, USN, ODUSD(R)(RP&A)

Approaches to Monitoring Readiness
Dr. Jim Jondrow, Center for Naval Analyses

Readiness Indices
Dr. Dave Schrady, Naval Postgraduate School

Wednesday, 0830-1000
Development of Installations Readiness Metrics
Mr. Bob Osterhoudt, SAIC

Measuring USMC Readiness
Mr. Matt Robinson, Center for Naval Analyses

Managing Readiness
Dr. Peter Francis, Center for Naval Analyses

Wednesday, 1330-1500
COMPOSITE GROUP VI SESSION .... Ellis Hall

Wednesday, 1530-1700
Links from the Joint Training System Assessment Phase to Readiness
Dr. Mike Wagner, Dynamics Research Corporation

Use of a Computer Aided Exercise to Evaluate CINC Staff Training Based on the Universal Joint Task List
Dr. Sam Parry, Naval Postgraduate School

A Pipeline Model of Resources Affecting Unit Readiness
Mr. Paul Hogan, The Lewin Group

Thursday, 0830-1000
Army War Reserve Secondary Items - Requirement, Investment and Risk
Messrs. Alex G. Manganaris, ODUSD(R)(RP&A) and John Tillson, Institute for Defense Analyses

Pricing Practices in Revolving Funds and Effects on Readiness
Dr. Chris Hanks, RAND

Performance-Based Readiness Measures
Dr. Charles Tatum, Navy Personnel Research and Development Center

Thursday, 1330-1500
Mobilization and Deployment of National Guard Divisions
Mr. John Brinkerhoff, Institute for Defense Analyses

Measures of Effectiveness (MOEs) for Assessing Human Performance Readiness in Aeronautical Systems
Mr. Frank Gentner, Wright-Patterson AFB (AL/CFH/CSERIAC) and Dr. Winston Bennett, Jr., Armstrong Laboratory

Design of an Integrated Simulation Model to Relate Policies and Resources to Navy's Personnel/Training Readiness
Dr. Tim Liang, Navy Personnel Research and Development Center

Thursday 1530-1700
Effects of PERSTEMPO on Soldier Attitudes and Reenlistment Intentions
Dr. Bob Holz, Army Research Institute

Stressed Systems Study - Phase II
Maj. Robert Nuanes, Air Force Studies and Analyses Agency

WG29 - READINESS - Abstracts

Tuesday, 1030-1200
FYDP-Based Readiness O & M Macroanalysis

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Abstract not available at printing.

Funding and Readiness

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Even though readiness is the top priority of the Defense Department, neither the military Services nor the Office of the Secretary of Defense have the tools needed to project the readiness implications of prospective DoD budgets or to otherwise assess the adequacy of these budgets for attaining the desired levels of future readiness. This presentation discusses on-going work that seeks to remedy these shortcomings. Two lines of research are described. In the first, Service-wide readiness indicators are related to operations and maintenance funding directly associated with combat activities (known as mission O&M), as well as to a measure of force size for all four Services. The second analysis focuses on years in which readiness was considered adequate. Relationships between mission O&M and force structure are derived assuming the same relationships in the future will yield adequate levels of readiness spending. In general, good statistical fits exist using both techniques.

Tuesday, 1330-1500
Readiness Assessment Systems

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As part of the Quadrennial Review, and pursuant to ongoing attempts by OSD, CJCS and Service Chiefs to better understand the readiness of forces, an attempt was made to address deficiencies in DoD's readiness assessment system. A task force was established and co-chaired by DUSD(R) and J-38. This brief addresses the results of the task force. It discusses weaknesses in the current system, 'fixes' to address these deficiencies, and initiatives that address persistent readiness concerns.

Approaches to Monitoring Readiness

Dr. Jim Jondrow, Research Analyst
Ms. Jessica Oi, Research Programmer

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This paper addresses the following perennial questions in readiness analysis:

- How much readiness is enough? How much difference from this goal is a cause for concern?
- How can many readiness indicators be consolidated in a way that is useful for top management?
- Do these indicators indicate a move toward "hollowness," a continued move away from hollowness, or a different direction altogether? This helps address concerns that the next hollow force may blindside DoD because it looks significantly different.

This presentation illustrates answers to these questions using statistical techniques and data from Navy surfact combat ships and from Navy fighter and attack aircraft.

Readiness Indices

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Military readiness is understood as a general concept, but it lacks formal specification and thus is understood to mean different things to different people. Lacking definition, readiness is implicitly defined by the predictor or indicator variables used in various studies of readiness. This leads essentially hundreds or thousands of definitions of readiness. This state of affairs complicates discussion of readiness and decisions about the level of readiness which ought to be funded and maintained. The U.S. economy is similarly something which is loosely understood but lacks definition. Communication about the state of the economy and decisions about policy actions which influence the economy are aided by the existence of economic indices describing various facets of economic activity. The indices provide baselines and trend information that policy makers find useful and which aid in discussion of the economy among interested parties. Consequently military readiness would be well served by the sanction, creation, and maintenance of readiness indices.

Wednesday, 0830-1000
Development of Installations Readiness Metrics

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This presentation highlights the identification and definition of key "direct" mission areas for each type fleet supporting installation, including Naval Stations, Naval Air Stations, Naval Submarine Bases, Naval Magazines and Ordnance Centers, Naval Ship Yards, Naval Communications Stations, Naval Training Centers, Fleet and Industrial Supply Centers, and Critical Enabler Installations (e.g. Construction Battalion Centers). The current Shore Base Readiness Report (BASEREP) lacks the quantitative structure to allow accurate analysis and provide credible evidence of the status of readiness at shore installations. BASEREP allows the subjective collection of data and judgment by installation commanders to report readiness levels at their installations. A revised system with quantitative links (cause and effect) to operational readiness would provide the credibility needed to conduct more accurate analytical study, and thus allow senior leadership to better make informed resource allocation decisions for installations programs. Initial development of new metrics for the key "drivers" is being completed and results will be ready for review at the MORS Symposium. A follow-on task is being started which will used to develop a readiness forecasting model. This presentation will briefly summarize the newly developed metrics, lessons learned, and a description of expanded work in process.

Measuring USMC Readiness

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This study's main objectives are to:

- Develop management tools for measuring and assessing current USMC readiness status
- Compare current readiness status to past periods
- Create indexes that summarize USMC readiness trends
- Identify ways to predict USMC readiness

This presentation will focus on techniques and tools that CNA has been developing to help the Marine Corps understand the way readiness has changed over time. The ultimate goal of this work is to find better ways to link resources to readiness and improve senior decision making.

Managing Readiness

Dr. Laura Junor, Project Director
Dr. Jim Jondrow, Research Analyst
Dr. Peter Francis, Research Analyst

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In the wake of a changing defense climate, the Navy is continuing to find ways to adjust to its smaller size while maintaining its ability to respond when required. Prior research by these analysts developed methods of benchmarking, summarizing and modeling readiness data. This effort focuses these tools on managing readiness. The analysis provides insight into some important questions for readiness managers:

- *What is causing current readiness changes?* This is an important question for readiness managers to answer because the appropriate response to a change will depend on whether the change is a random event, an intended consequence of a new policy or an unexpected, persistent consequence of a change in a determinant.
- *Which readiness determinants are likely to cause severe problems if they are not managed closely?* This readiness model highlights those determinants that have the largest (statistical) impact on readiness. They are the indicators to protect or, at least, manage carefully.
- *What are the readiness consequences of changing levels of key determinants?* This model also explains how much readiness will change given a change in a determinant. This tool allows one to evaluate, for example, the readiness consequences of policy alternatives.

<u>Wednesday, 1530-1700</u>
Links from the Joint Training System Assessment Phase to Readiness

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The Joint Staff (J-7) and the Joint Warfighting Center are implementing a process by which joint force commanders analyze their missions and establish mission requirements. These requirements are described using a common language of tasks, conditions, and standards based on CJCSM 3500.04A, the Universal Joint Task List (UJTL). These requirements provide a basis for planning, conducting, and assessing joint training in accord with processes described in CJCSM 3500.03, the Joint Training Manual.

During the past year, the "assessment" phase of the Joint Training System was redesigned to take advantage of the JTS's requirements-based architecture. The foundation of a good assessment process must be built on a sound description of requirements (against which one can compare observed performance) and on the collection of objective performance data (used to make the comparison) that can be related to these requirements. The joint training system, with its structured approach to both of these activities, has this foundation. Consequently a process was developed with much greater potential to support readiness assessment than the previous system.

While the concept of readiness is broad and has many facets, central to it is predicting the ability of the military to execute assigned missions and the relationship of various resources (e.g., O&M, R,D&A) to the military's capability to execute these missions. The Joint Training System has the potential to produce performance data that can be related quite directly to the mission capability question.

Summary: This paper will describe the emerging Joint Training System (JTS) assessment phase and will illustrate how this process can support readiness assessment.

Use of a Computer Aided Exercise to Evaluate CINC Staff Training Based on the Universal Joint Task List

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This paper presents emerging results from a continuing research effort to develop measures of effectiveness for tasks in the Universal Joint Task List (UJTL) related to several functional areas. The primary emphasis is to provide the staff planner with an ability to associate causal reasons for critical events in an actual CINC exercise using actual runs from the Joint Theater Level Simulation (JTLS). The UJTL, a supplement to the Joint Training Manual, is a comprehensive listing of all joint tasks pertaining to the Armed Forces of the United States. Tasks are defined as they relate to the strategic, operational, and tactical levels of war. This research, initiated in October 1994, developed an exercise analysis methodology for evaluating CINC staff performance in the execution of joint tasks during the conduct of a Computer Aided Exercise (CAX). Five different JTLS theater conflicts were run to provide the data base for analysis. Causal reasons were developed for critical events which occurred in six functional areas: ground maneuver forces, protection of high value assets (both land and sea based), prosecution of enemy high value targets, amphibious operations, and force deployment. This research continues in FY97.

A Pipeline Model of Resources Affecting Unit Readiness

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Approved abstract not available at printing.

Thursday, 0830-1000

Army War Reserve Secondary Items – Requirement, Investment and Risk

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The Army identified a shortfall of $3.1 billion in war reserve secondary items (spare parts, subsistence, medical and pharmaceutical supplies, among others) in their submission of the FY98-03 Program Objective Memorandum (POM). The Army characterized this shortfall as acceptable risk. The Program Decision Memorandum (PDM) signed by the Deputy Secretary of Defense directed the OSD, Joint Staff and Army staff to review Army requirements, quantify the risks associated with any maldistributions or shortfalls, and suggest possible actions to mitigate risks.

This analysis shows the following: Army requirements appear to be overstated, risks of not funding the Army shortfall are small; refinements are needed in the requirements generation process; measures to improve the industrial base or to provide rolling inventories may mitigate risks more effectively than purchasing additional inventory; and an overall investment strategy needs to be developed which minimizes the risk to war time readiness.

Pricing Practices in Revolving Funds and Effects on Readiness

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All of DoD's central logistics activities providing supply, maintenance, and distribution goods and services are financed by Working Capital Funds (WCFs). These activities continue to charge operating-force customers full-cost-recovery prices in accordance with pricing practices first implemented FY 1992. In response to these prices, customers have natural incentives to delay, postpone, and, if possible, avoid doing business with WCF activities. Such customer reactions can have both direct and indirect effects on materiel readiness, sometimes for good, sometimes for bad. This presentation describes the theoretical basis for the effects and discusses the problem of determining whether readiness effects are occurring systematically.

Performance-Based Readiness Measures

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In a recent report on the status of readiness measurement (Tatum, Nebeker, Appleton & Laabs, 1996), researchers from the Navy Personnel Research and Development Center (NPRDC) concluded that the current system for measuring and reporting Naval readiness is less than ideal. Other reports have reached a similar conclusion for the Armed Services in general (Congressional Budget Office [CBO], 1994; Defense Science Board [DSB], 1994; General Accounting Office [GAO], 1994a, 1994b; Moore, Stockfisch, Goldberg, Holroyd & Hildebrandt, 1991). This presentation documents the efforts of NPRDC to create a data base of measures that can be used to study and improve the process by which the Navy assesses its military readiness. The presentation begins with a discussion of past problems in developing measures of readiness and then explains how NPRDC has attempted to identify data sources that met several strict criteria (e.g., performance -based, objective, reliable, multi-leveled). Preliminary attempts at validating the readiness measures and exploring predictive relationships are described. The presentation concludes with recommendations for collecting and analyzing data that improves the Navy's and the Armed Service's ability to assess and forecast readiness.

Thursday, 1330-1500

Mobilization and Deployment of National Guard Divisions

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The time it would take a National Guard armored or infantry division to mobilize, process, train, and deploy to an overseas theater is controversial. There are few studies and no relevant historical data on this issue. Yet, the time it would take to employ these combat formations is an important factor in determining the appropriate use of these combat forces in the post-Cold War era. This paper presents the results of a study of the intrinsic capability of a National Guard armored division to mobilize, train, and deploy to Korea for a combat mission. The study results are evaluated, and the extent to which they can be applied to other divisions is discussed. The study assumes that adequate external resources are available when needed, and the consequences of resource shortages or delays are considered in the evaluation of the study. Finally, the consequences of the study findings for Active-Reserve integration are addressed.

Measures of Effectiveness (MOEs) for Assessing Human Performance Readiness in Aeronautical Systems

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Air Force (AF) Major Command (MAJCOM) decision-makers often have difficulty understanding how much improved war-fighting capability or readiness can be expected from investments in Manpower, Personnel, and Training (MPT) Research and Development (R&D). MPT R&D findings have not usually related directly to war-fighting Measures of Effectiveness (MOEs). Instead, they are related to individual performance, rather than unit operational outcomes. The utility of MPT R&D could be more effectively demonstrated by linking combat capability and readiness MOEs with innovative organization-level approaches to training effectiveness measures. This way, decision-makers could more readily see impacts of advanced training technology. Since no comprehensive listing of aeronautical system MOEs exists in the literature, researchers may find this approach difficult. Therefore, based on an extensive literature search, MOE workshops, and examining human-system interface criteria for judging mission effectiveness, CSERIAC constructed the Human-System MOE/MOP Taxonomy for Aeronautical Systems. Next, CSERIAC will use the MOE hierarchy to capture criteria for judging unit readiness and effectiveness from AF decision-makers. Important measures will be linked to MPT effectiveness metrics, which can more clearly demonstrate the value of advanced training and screening technology. Finally, relationships between CSERIAC's efforts and a more micro-level effectiveness assessment project are described. This micro-level project focused on reliability and validity characteristics of Work-group, Unit, Squadron, and Base-level readiness and effectiveness measures as potential criteria for training evaluation. From the combined efforts a comprehensive taxonomy of relevant criteria and offices which develop/use the criteria will be available -- initially for the Air Force -- but eventually for all the Services.

Design of an Integrated Simulation Model to Relate Policies and Resources to Navy's Personnel/Training Readiness.

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Jules Borack, Ph.D.,G S-15, Operations Research Analyst
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Forecasting personnel and training readiness requires quantifying numerous factors. These factors include personnel/training inventory, flows, policies, and costs related to attrition, promotion, accession, classification, skill training, rotation, distribution, advanced skill training, deployment, unit readiness, etc. All of these factors are interrelated.

Due to the complexity of quantifying overall personnel/training readiness, current analytical and modeling methods are limited to quantifying certain specific parts of the overall issue. With different models analyzing components of the personnel and training system, there is no way to measure the impact changes in factors in one model on the overall system.

This study found that the overall personnel/training readiness problem is a single integrated problem. It requires the development of an integrated model to link all variables together. The integrated model consists of a number of modules which each address a key personnel/training subsystem.

IDEF0 and IDEF1X tools were used to reengineer an integrated personnel/training functional process. A simulation model is being developed to quantify the new integrated process. The ultimate goal is to provide managers with an analytical tool to measure the impact of policies and resources on readiness and to project future readiness implications of policy and budgetary decisions.

Thursday 1530-1700

Effects of PERSTEMPO on Soldier Attitudes and Reenlistment Intentions

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Some military strategists have expressed concern that increasing the use of military personnel for peace keeping and peace making operations (activities that fall under the general heading of "operations other than war" - OOTW) will lead inexorably to increases in personnel tempo - PERSTEMPO - and then to reduced levels of satisfaction with the military and ultimately to lower levels of reenlistment. Some have even posed the notion that increases in OOTW could result in the demise of the all-volunteer force. To address some of these concerns, statistical analyses were conducted on recent (1996) survey data from soldiers in military occupational specialty (MOS) that is characterized by relatively high levels of PERSTEMPO - namely Military Police. The analyses examined the relationships between levels of PERSTEMPO and recent peace keeping operations and job satisfaction, morale, motivation, family and personal stress and reenlistment intentions. Results suggest that the effects of increased PERSTEMPO may not be directly related to increases in negative attitudes or to reduced levels of reenlistment intentions. The relationship between heightened PERSTEMPO and attitudes is probably more complex and non-linear and could benefit from more detailed inquiry.

Stress Systems Study Phase II

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The purpose of this study was to quantify and measure the negative effects of the current OPTEMPO/PERSTEMPO on people and equipment as well as to provide a set of observations and recommendations that mitigate the negative effects of stress. Analysts from Air Force Studies and Analyses (AFSAA) visited over 45 units (operational and support) to collect 33 personnel indicators and 11 equipment indicators of stress. In addition, anecdotal stories, records, and surveys were gathered. Observations were formed for particular units or systems. A spreadsheet model, "Unit's Comprehensive OPTEMPO/PERSTEMPO Estimator" (UCOPE), was developed and applied to determine, which indicators recorded the highest levels of stress; which unit(s) were the most stressed; and which of the 28 solutions (tailored to the particular unit) would help the stressed unit limit and/or meet taskings. Briefings were given to many members of the senior Air Force leadership up to and including the Air Force Chief of Staff. The study, along with the 7 observations and 6 recommendations were well received. AFSAA is assisting Air Force Public Affairs in orchestrating maximum exposure of OPTEMPO/PERSTEMPO issues and will be consulting with an integrated process team (IPT) to study the impact of implementing and tailoring some of the solutions prior to a senior Air Force leadership meeting in June and prior to the initiation of Stress Systems Study Phase III.

WG 30 - Decision Analysis - Agenda

Chair: LTC Dan Maxwell, US Army Concepts Analysis Agency
CoChairs: LTC Jack Kloeber, Air Force Institute of Technology
Mr. Frank Papparozzi, ANSER, Dr. Steve Fought, Naval War College
Advisor: Dr. Greg Parnell, Virginia Commonwealth University
Room: Diamond Hall – CR-3

Room: Diamond Hall – CR-3

Tuesday 1030-1200
Integrating Multi-Attribute Utility Theory and Mathematical Programming: Tools & Techniques
LTC Dan Maxwell, US Army Concepts Analysis Agency

Practical and Theoretical Considerations When Integrating Linear Programming and Multi-Attribute Utility Theory: Lessons Learned in Large Scale Applications
LTC Daniel T. Maxwell, LTC Roger Pudwill and Ms Linda Coblentz, USACAA

Resource Allocation Tools and the Tech Base Planning Process
Diane B. Affleck and John D. Walther, ERDEC

Tuesday 1330-1500
Multi-Criteria Models to Support Course of Action Selection / Planning
Mr. Freeman Marvin, The Analytic Sciences Corporation

Using the Analytic Hierarchy Process in a Cost and Options Analysis
Don Llynick and Robin Kane, ANSER Corporation

Evaluation and Analysis of Decontaminants
Diane B. Affleck, ERDEC and Freeman Marvin, TASC, Inc.

Evaluation of Alternative Demil Technologies
John D. Walther, ERDEC and Freeman Marvin, TASC, Inc

Wednesday 0830-1000
Embedding Decision Theory In Combat Models
Colonel Gary Q. Coe (USA - retired), Institute for Defense Analyses

Concept Exploration on the Virtual Battlefield
Gary Q. Coe, IDA

Decision Analysis in JWARS
Charles Leake, Ph.D, JWARS

Simulating Nonlinear Conflict Dynamics
Thad A. Brown, University of Missouri

Wednesday 1330-1500
Panel Discussion "How do we market Decision Analytic Thinking to the "Powers that be?"....or Missed Opportunities for Rational Thinking..."
LTC Dan Maxwell, US Army Concepts Analysis Agency

Wednesday 1530-1700
Decision Analysis in Support of Campaign Modeling
LTC Wm. Forrest Crain, US Army Concepts Analysis Agency
The Logistics Anchor Desk-Supporting the CINC's Campaign Plan
Hugh M. Denny and Patricia M. Jones, US ARL

Warfighting Analytic Support to the Third US Army
LTC Wm. Forrest Crain, USA Concepts Analysis Agency

QFD vs. Decision Analysis: An R&D Case Study
Gwen Delano, Joint Warfare Analysis Center, Matt Vance, McDonnell Douglas and Dr. Gregory Parnell, Virginia Commonwealth University

Thursday 0830-1000
COMPOSITE GROUP VII SESSION..Ellis Hall

Thursday 1330-1500
Decision Analysis *In Support of Space Systems Decision Making*
Mr. Frank Papparozzi, ANSER

Cost Benefit Analysis of Airborne and Space-borne Reconnaissance Force Mixes
Terry Bresnick, Innovative Decision Analysis, Prof Dennis Buede, George Mason University and Al Pisani, TASC

Air Force 2025 Operational Analysis
LtCol Jack A. Jackson, AFIT/ENS, Dr. Gregory Parnell, VCU, LtCol Brian L. Jones, Air War College, Maj Lee Lehmkuhl, HQ USAFA/DFMS, Maj Harry Conley, Joint Simulation System Program Office and LtCol John Andrew, Air Force Modeling and Simulation Agency

Mission Area Planning: A Value Focused Thinking Approach
Maj David T. Taylor, Space Warfare Center

Thursday 1530-1700
Decision Analysis Projects
LTC Jack Kloeber, US AFIT

Defense Program Projection (DPP) Robust Analysis for Extended Planning
Phillip A. Richard, GRCI and Dr. Will Jarvis, OSD PA&E

Saving Time and Valuable Resources for NAIC
Capt Steven M. Cox, AFIT/ENS

McDonnell Douglas Aerospace Requirements-Based Decision Analysis Using Quality Function Deployment
Gary Gill, McDonnell Douglas Aerospace

WG30 - DECISION ANALYSIS - Abstracts

Tuesday 1030-1200
Integrating Multi-Attribute Utility Theory and Mathematical Programming: Tools & Techniques
LTC Dan Maxwell, US Army Concepts Analysis Agency

Practical and Theoretical Considerations When Integrating Linear Programming and Multi-Attribute Utility Theory: Lessons Learned in Large Scale Applications

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Significant advances in the computer and computational sciences are allowing analysts to address increasingly complex problems. As these advances are applied to the complex problems faced by governmental and industrial leaders the demand for ever increasing levels of complexity in computer based modeling and analysis also increases. Many of the problems faced by these leaders are characterized by both large combinations of alternative solutions and multiple, often competing objectives. Linear programming and decision analysis are two mathematical modeling tools that are designed to address these types of problems. Analysis reports and software tools are emerging that are beginning to integrate these techniques. However, each of the techniques have properties that must be considered if they are to provide a meaningful integrated model. We describe a multi-billion dollar resource allocation problem that has benefited from such

analysis. We outlines the principal axioms of each technique, and properties that must be preserved as the model is desegregated and reassembled for integrated analysis. Finally, we address some practical considerations that are highly useful in communicating analysis results to clients.

Resource Allocation Tools and the Tech Base Planning Process

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ERDEC and TASC are jointly developing an approach which allows resource allocation decisions, such as the Joint Service Tech Base Planning (TBP) process for funding CB defense research and development projects, to be made using cost-benefit and optimization tools. The Resource Allocation Decision Support System (RADSS) is a tool to help decision makers maximize return on investments in situations where there are many investment options and multiple constraints. RADSS can be used for capital budgeting, new product development, research and development decisions, labor allocations across different programs, market entry strategies, project selections, and technology investments. RADSS combines a project data base, multi-criteria benefits assessment, linear programming optimization, and scenario analysis to provide a complete resource allocation capability. The presentation will conclude with a discussion of how RADSS and other tools may help address the TBP issues.

Tuesday 1330-1500
Multi-Criteria Models to Support Course of Action Selection / Planning
Mr. Freeman Marvin, The Analytic Sciences Corporation

Approved abstract not available at printing.

Using the Analytic Hierarchy Process in a Cost and Options Analysis

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This presentation discusses how the Analytic Hierarchy Process (AHP) was used in a Cost and Options Analysis to provide a military client with the information needed to select the best alternative to improve a major Air Force weapon system.

Initially, Functional Objectives (FOs), Measures of Effectiveness (MOEs), and Measures of Performance (MOPs) were developed in line with the Air Force Modernization Planning process. The MOEs became the first level of criteria under the goal in an AHP structure, followed by the MOPs as sub-criteria and finally, the proposed alternatives at the bottom level of the hierarchy. Then, operator and technical analyst inputs were collected to derive the weights of all criteria. Next, performance data was collected and synthesized to compute the ratio scales for all proposed alternatives. Prior to the input of data, utility functions were developed to ensure all performance data across all criteria were in the same units. A separate structure to analyze the effectiveness, cost and technical risk of each alternative was designed. Finally, risk adjusted cost-effectiveness ratios for each alternative in a variety of scenarios were computed.

Five different alternatives were compared to the current system in order to evaluate the possibilities. This briefing will primarily explain the methodology, discuss the Measures of Effectiveness (MOEs) and Measures of Performance (MOPs) evaluated, and present sanitized results (to protect contractor and program identities) of the analysis in terms of the cost-effectiveness ratios.

Evaluation and Analysis of Decontaminants

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The Operations Research and Analysis Team and its support contractor, TASC, were asked to assist several Army organizations making decisions relating to the problem of "What to do with the DS2 stockpile at Seneca Army Depot, NY." The majority of the stockpile of DS2, the current decontaminant used by the Army, is stored at Seneca Army Depot, NY. Maintenance of the stockpile presents funding and environmental problems, and Seneca Army Depot is scheduled to close in FY99 due to the Base Realignment and Closure (BRAC) law.

Evaluation of Alternative Demil Technologies

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ERDEC's Operations Research and Analysis Team and their support contractor TASC provided decision support to the Product Manager for Alternative Technologies and Approaches (PMATA) to evaluate potential technologies for demilitarization of chemical agent stockpiles in two states. The candidate demil processes included three commercial- and two government-developed technologies, as well as the baseline approach of incineration.

Wednesday 0830-1000
Embedding Decision Theory in Combat Models
Colonel Gary Q. Coe (USA - retired), Institute for Defense Analyses

Concept Exploration on the Virtual Battlefield

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Virtual simulation excursions to investigate the efficacy of the small team concept on a 2015 battlefield were conducted at the Institute for Defense Analysis (IDA) Simulation Center for the 1996 Defense Science Board (DSB) Summer Study on Tactics and Technology for 21st Century Military Superiority. The terms of reference for the DSB Study focused "...on the concept of making relatively small and rapidly deployable forces (or teams) --specially equipped, trained, and supported by remote sensors and weapons -- able to accomplish missions heretofore only possible with much larger and massed forces."

Decision Analysis in JWARS

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The Department of Defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

More than any other representations contained in JWARS, the representation of operational level decision making will have a profound impact on future force structure, procurement and planning policies. This brief will provide an overview of the types of analyses JWARS will support, an open discussion of the methods by which JWARS will represent decisions, and a report on the status of JWARS development.

Simulating Nonlinear Conflict Dynamics

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Agent based simulations are used to investigate conflict dynamics. The agents reflect individual entities operating on a complex landscape. The landscape is dynamic, governed by systems similar to Liggett's interactive particle systems. These dynamics are investigated on a lattice in Z**d. Individual agents have local state. The political landscape can be either smooth and rugged. Unlike other simulation efforts, there is not explicit fitness function.

In preliminary simulations, the system has displayed surprisingly complex behavior. We have observed the formation of groups and hierarchies within political resource dependencies. The process by which elites emerge is not uniform. Indeed there are multiple elites required for a complex system to evolve. We observe that elites are often situational, which is emerge suddenly depending on the context confronted by the group or ensemble of agents.

We are also interested in how rules of interaction evolve based on conflict. One of our expectations is that as two competing states develop progressively more complex offensive and defensive strategies, the rules that govern their interaction also evolve. Such rule evolution may reflect the sensitivity of elites to differing levels of renewable resources. Or it may reflect the elites' response to multi-criterion decision making. The outcome we observe is for various elites to develop idiosyncratic, but contextually dependent, strategies. Such strategies are rarely anticipated. Such strategies appear to govern sophisticated behavior by elite agents.

Wednesday 1330-1500

Panel Discussion "How do we market Decision Analytic Thinking to the "Powers that be"....or Missed Opportunities for Rational Thinking..."

LTC Dan Maxwell, US Army Concepts Analysis Agency

Panel Members:
Dr. Gregory Parnell
Virginia Commonwealth University

Professor Dennis Buede
George Mason University

Lt Col. Jack A. Jackson
US Air Force Institute of Technology

Decision analysis is "a collection of tools and techniques and bits of lore and craft" that can be applied to the difficult decision situations military leaders face. A common criticism of decision analysis is its difficulty to implement in organizations and explain to decision makers. This panel will present the ideas of some experienced, successful, decision analysts. After short presentations there will be the opportunity to discuss current challenges faced by decision analysts in the military OR community.

Wednesday 1530-1700

Decision Analysis in Support of Campaign Modeling

LTC Wm. Forrest Crain, US Army Concepts Analysis Agency

The Logistics Anchor Desk- Supporting the CINC's Campaign Plan

Hugh M. Denny, Patricia M. Jones
Joint Logistics Advanced Concept Technology Demonstration Project Office
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This paper will address the technical and functional aspects of an OSD sponsored project that applies Artificial Intelligence (AI) technology to address the military logistics functions that are crucial to successful battle commanders. This project, The Joint Logistics Advanced Concept Technology Demonstration (JL-ACTD) operates under novel Department of Defense (DOD) guidelines outside those covered in DODI 5000 Evolutionary Acquisition Strategies. The technology deliverable of this program is called the Logistics Anchor Desk (LAD). The LAD is a prototype logistics operation cell where current logistics information is a readily available and powerful analytical tool and simulations provide the capability to examine CINC warfighting sustainment issues.

Warfighting Analytic Support to the Third US Army

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The US Army concepts Analysis Agency has developed a warfighting analytical support team which has demonstrated the capability to provide a deployable, responsive, real time warfighting campaign analysis to the theater level commander in the field. This significant accomplishment is the result of combining several advancements in operations research techniques, decision analysis methods, state-of-the-art hardware and software developments packages. Utilized by US Central Command (CENTCOM) and US Army CENTCOM (ARCENT), WAS-TUSA has been employed to conduct course of action assessments, determine force allocation and requirements, develop war plans and serve as an exercise "driver." During Desert Storm, such analysis was conducted using a mainframe and typically required 5 days to complete a course of action assessment. WAS-TUSA enables the same task to be accomplished in 2-3 hours to include production of decision maker quality products. Lieutenant General Arnold, commander of ARCENT, describes WAS-TUSA as "...truly revolutionary, significant and influential ..." and "...this capability could and should soon be proliferated to corps and divisions." Clearly, WAS-TUSA is an analytical quantum leap forward in leveraging today's technology.

QFD vs. Decision Analysis: An R&D Case Study

Gwen Delano
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Joint Warfare Analysis Center, Dahlgren, VA

Matt Vance
McDonnell-Douglas
St Louis, MO 63166

Dr. Gregory s. Parnell
Department of Mathematical Sciences
Virginia Commonwealth University

We examine a significant QFD R&D study and redo parts of the study using decision analysis techniques. First, we summarize the key QFD study modeling assumptions. Second, we convert the QFD matrices to a mulitobjective value model and develop single dimensional value functions for each of the attributes. Third, we evaluate the alternatives with the value model. Fourth, we perform an uncertainty analysis on a few of the key variables. Finally, we conclude with a comparison of the two methods.

Thursday 0830-1000

Composite Working Group

LTC David Hutchinson

Cost Benefit Analysis of Airborne and Space-borne Reconnaissance Force Mixes

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Today's operational commanders are increasingly relying on joint intelligence, surveillance, and reconnaissance (ISR) for decision making and targeting. In 1995 the Joint Requirements Oversight Council (JROC) recognized that it had no means to make an end-to-end evaluation of cost-effective ISR force mix alternatives that included manned, unmanned, and overhead assets. This paper describes the analytical approach that was developed to support the JROC need for conducting a cost-benefit analysis of a wide range of ISR end-to-end force mixes.

Air Force 2025 Operational Analysis

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In the summer of 1995, the Air Force chief of staff tasked Air University to do a year-long study, **Air Force 2025**, to "generate ideas and concepts on the capabilities the United States will require to possess the dominant air and space forces in the future [, to identify] new or high-leverage concepts for employing air and space power [, and to detail] the technologies required to enable the capabilities envisioned." We conducted an operational analysis using Value-Focused Thinking to identify high-value system concepts and their enabling technologies in a way that was objective, traceable, and robust. We developed the ***Foundations 2025*** value model and identified the system concepts that showed the greatest potential for enhancing future air and space capabilities and the embedded technologies with the highest leverage in making the high-value system concepts a reality. Six alternative futures were identified and a sensitivity analysis was performed to see how sensitive the best systems were to the alternative futures. The ***Foundations 2025*** value model was a significant analysis achievement and has several important future uses.

Mission Area Planning: A Value Focused Thinking Approach

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Approved abstract not available at printing.

Thursday 1530-1700
Decision Analysis Projects
LTC Jack Kloeber, US AFIT

Defense Program Projection (DPP) Robust Analysis for Extended Planning

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The Defense Program Projection (DPP) is a long-term projection of DoD programs based on the President's Budget FYDP and other official documents. It is the joint venture of OD PA&E and USD(A) API to meet Defense Management Review requirement for: "... a rough, 20-year "road map" of the modernization needs and investment plans of DoD, projecting the impact of the Program Planning Objectives, and of additional modernization or replacement of major systems (e.g., ships, aircraft, tanks and satellites) expected by the Military Department and Defense Agencies, against realistic levels of future funding."

The DPP effort results in a projection of the Future Years Defense Plan (FYDP) database twelve years beyond the end of the FYDP, currently out to FY 2015. Inputs to this analysis include the FYDP, analyst projections of the force structure, investment projections based on current Service plans, as well as OD PA&E and USD(A) API projections of the consequences of those plans. The DPP includes high and low excursions as well as an analysis and characterization of the budget, policy, and affordability risk inherent in the projection. DPP data and analyses have been used in the past in supporting the Bottom Up Review (BUR) and will be used in the Quadrennial Defense Review.

The DPP study effort uses several measures of merit to determine investment adequacy and program supportability. These measures include average fleet age, age distribution, steady state procurement, affordability, and force modernization rate. A major portion of the DPP presentation to high level DoD officials consists of highlighting the extent to which Service investment programs comply with these PA&E determined goals.

This presentation focuses on the process of determining, analyzing, and reporting investment program compliance with program goals.

Saving Time and Valuable Resources for NAIC

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The National Air Intelligence Center (NAIC), faces many problems with resource allocation as other organizations do. This research focuses on developing a strategy for NAIC's resource allocation process that will save valuable time and resources using value-focused thinking and multi-attribute utility theory. Decision analysis software is used to help accomplish this task.

McDonnell Douglas Aerospace Requirements -Based Decision Analysis Using Quality Function Deployment

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Since 1991, McDonnell Douglas Aerospace (MDA) has successfully defined emerging program requirements with a Decision Analysis adaptation of Quality Function Deployment (QFD). QFD is a Total Quality Management process recognized for its contributions to the Japanese and American automobile industries and has been identified as a structured, rigorous process for translating the "Voice of the Customer" into manufacturing specifications. At MDA we have adapted QFD into a versatile process for 1) system requirements generation and definition, 2) prioritization of design characteristics and technologies, and 3) generation and ranking of alternative solutions. The use of matrices and functional decomposition facilitates a value-focused, as opposed to alternative-focused, requirements tracking process. Scoring is typically based upon utility, performance, cost, or risk. MDA has used this process in approximately 100 diverse applications involving both internal and external customers. The combination of a structured approach with the flexibility to adapt to each customer's needs makes MDA's requirements-based approach to QFD a valuable process for sorting through non-negotiable, elusive, or changing requirements.

WG31 - COMPUTING ADVANCES IN MILITARY OPERATIONS RESEARCH - Agenda

Chair: Major William S. Murphy, Jr., TRADOC Analysis Center-Monterey
Cochairs: Captain Jeffrey L. Huisingh, TRADOC Analysis Center – Monterey
Pamela J. Blechinger, TRAC-OAC
Howard J. Carpenter, MITRE
Advisor: LTC James R. Wood, Director, TRADOC Anlysis Center - Monterey
Room: C&SC – CR-146 and MCRC – CR-165

Room: C&SC – CR-146

Tuesday, 1030-1200
Analysis Using the High Level Architecture
MAJ Leroy A. Jackson, US Army TRADOC Analysis Center-Monterey

BroadCAST - ARSI Combat Development Environment Project
David R. Durda and Robert Koury, Texas Instruments

Analysis with DIS, Making the Most of What's There
Mr. Neal T. Lovell, Computer Sciences Corporation and Ms. Laurie Fraser, US Army, MICOM

Tuesday, 1330-1500
Soldier Station: Exploiting HLA for Dismounted Infantry Analyses
Shirley Pratt, US Army TRADOC Analysis Center and David Pratt, Computer Science Department, Naval Postgraduate School

Virtual Prototyping at USMA
James E. Armstrong, LTC and Associate Professor, Craig T. Doescher, Captain and Instructor, Brandon Agbayani, Cadet, Keith DeGregory, Cadet, Andy McDonald, Cadet, Tom Scarberry, Cadet, Department of Systems Engineering, United States Military Academy

A Graphical Tool for the Creation of Terrain Data Files
Dr. Imre L. Balogh, Nations Inc,

Wednesday, 0830-1000
Simulation in Support of Developmental and Operational Testing for the Predator SRAW
Matthew M. Aylward, Gary R. Brisbois, Sara F. McCaffery, The MITRE Corporation

Advanced Sub-system, Element, and System Simulation (ASESS)
Callie M. Hill, Principal Engineer, Teledyne Brown Engineering

Wednesday, 1330 -1500
Displaying Live Entities in DIS Simulations
MAJ William S. Murphy Jr., US Army TRADOC Analysis Center-Monterey

The Joint Warfare System (JWARS) Software Development Process
LTC Terry W. Prosser, Office of the Secretary of Defense (Program Analysis and Evaluation)

Preliminary Guideline for Distributed Simulation Analysis and Engineering Applications
Dr. Dale Pace, Applied Physics Lab and Leroy A. Jackson, Major, Operations Research Analyst
US Army TRADOC Analysis Center-Monterey

Wednesday, 1530 -1700
Facilitating Information Flow in Wargames
LTC Robert Kilmer, US Army War College

Concept Exploration on the Virtual Battlefield
COL Gary Q. Coe, Institute for Defense Analyses

Model Building in JWARS
MAJ Barry D. Justice, Office of the Secretary of Defense (Program Analysis and Evaluation)

Thursday, 0830-1000
COMPOSITE GROUP VII SESSION..Ellis Hall

Room: MCRC – CR-165

Thursday, 1330-1500
Massively Parallel Solutions of Large Multi Echelon Inventory Problems
Dr. Meyer Kotkin, Operations Research Analyst, Mr. Thomas Hagdorn, Operations Research Analyst, Mr. Martin Cohen, Operations Research Analyst, US Army Material Systems Analysis Activity (AMSAA)

Thursday, 1530-1700
Anti -Armor Advanced Technology Demonstration (A2ATD): Summary of all Experiments
Michael J. McCarthy, Jamaine Burrell, Mark Burrough, Lilly Harrington, Don Hodge, Irene Johnson, Sylvia Nguyen, Joseph Pinto, Mike Schmidt, Floyd Wofford, Tom Ruth, Wilbert Brooks, US Army Materiel Systems Analysis Activity (AMSAA)

MOE Sensitive Management for Multitrajectory Simulation
John B. Gilmer, Wilkes University

WG31 - COMPUTING ADVANCES IN MILITARY OPERATIONS RESEARCH - Abstracts

Tuesday, 1030-1200
Analysis Using the High Level Architecture

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The US Army TRADOC Analysis Center at Monterey has proposed an integrated approach to analysis in advanced distributed simulation (ADS) using the high level architecture (HLA). We claim that this approach fully embraces the HLA from the point of view an analyst who might use a distributed simulation for a study. We assess in general terms how this analyst might specify data requirements, develop a data collection scheme with resource allocation, and verify that the data will fulfill the study requirements. We also suggest software tools that support this proposal. This paper summarizes that proposal and explains how many of the same tools developed for analysis in advanced distributed simulations can support analysis in stand-alone simulations. The level of model abstraction provided by the HLA simulation object model (SOM) can serve the analytical community as it strives to satisfy unanticipated demands in complex, uncertain times. Consensus on analysis requirements in Advanced Distributed Simulations will allow the analysis community to exploit the HLA standard by crafting general purpose tools that support a broad range of analytic needs.

BroadCAST - ARSI Combat Development Environment Project
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The TRADOC Analysis Center at White Sands Missile Range (TRAC-WSMR) has entered into a joint effort with an industry

partner, the Defense Systems & Electronics Group of Texas Instruments Incorporated, to build analytic tools and interfaces to utilize BroadCAST, a DIS complaint version of the CASTFOREM combat simulation model with the Texas Instruments' ARPA Reconfigurable Simulator Initiative (ARSI) manned simulator. This project is designed to create the interfaces and procedures which will allow the combination of a manned simulator (ARSI), a virtual simulation (ModSAF), and a high-resolution constructive model (BroadCAST), in order to build a nearly seemless combat development environment. This combat development environment will allow the introduction of man-in-the-loop stimulus via the simulator or virtual model into BroadCAST as a means of studying man-machine issues and to qualify military judgment/expertise. This should provide the ability for live reaction to the constructive simulation characteristics, while in a free-play role in a virtual simulation, and also to perform detailed analysis of the impact of adding a man into the analytic loop of a high analytic fidelity constructive simulation. This paper will discuss the planned efforts and show the benefits of using a high-resolution, replicable, constructive model linked to DIS/HLA complaint simulator(s) to enhance analytic capabilities of current and developmental weapons systems.

Analysis with DIS, Making the Most of What's There

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Approved abstract not available at printing.

<u>Tuesday, 1330-1500</u>
Soldier Station: Exploiting HLA for Dismounted Infantry Analyses

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Soldier Station is a networked, human-in-the-loop, virtual dismounted infantryman (DI) simulator with underlying constructive model algorithms for movement, detection, engagement, and damage assessment. It is being developed by TRADOC Analysis Center - White Sands Missile Range to analyze DI issues pertaining to situational awareness (SA), command and control (C2), and tactics, techniques and procedures (TTP). Currently, Soldier Station uses Distributed Interactive Simulation (DIS) protocols. However, several extensions to existing DIS protocols have been necessary in order to adequately represent complex DI entities and their interactions in our analytic simulations. In addition, the communication of perceived data (i.e. C2, SA and TTP) crucial for analysis purposes, among outside networked systems and between the two internal networked system components which comprise one Soldier Station, is not well supported in DIS. Consequently, it is accomplished using other networking means.

To overcome these DIS limitations, we will exploit the new High Level Architecture (HLA) paradigm. HLA's inherent flexibility and distributed nature supports the communication of both truth and perceived data. It also facilitates the addition of future system components for hardware-in-the-loop analyses. HLA's hierarchical nature allows for the consideration of both internal HLA's compliance between Soldier Station system components and external HLA compliancy with other networked systems. Representations of Soldier Station as one physical federates are possible. This paper will focus on system redesign issues and the projected enhancements to Soldier Station's analysis capabilities which result when exploiting the HLA philosophy.

Virtual Prototyping at USMA

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Brandon Agbayani, Cadet, United States Military Academy
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The smaller defense budgets and rapid pace of technological advances has created the need to find ways to reduce the cost and time of developing and testing new complex battlefield systems. VP is one technique that has tremendous potential. Examples from the commercial sector include the airline company, Boeing, which has proven this potential by using virtual prototyping in developing the new 777 airplane and saving millions of dollars. Virtual prototyping and advanced distributed simulation have generated interest in the Army training communities, but it is not clear how analytical communities will be able to benefit from these emerging technologies. The purpose of this research is to design a system that addresses the configuration and use of virtual prototyping resources in an optimal way to investigate analysis and design issues.

One of the results will be a methodology for categorizing virtual resources so when they become available, they can be properly assessed and used. During the initial phase of the research functions and capabilities of existing VP tools were explored. The next phase of the research focuses on the design of experiments to investigate the credibility of using VP technologies for analytical problems. Next a methodology will be proposed that will lay out how to investigate specific design issues. Although this project is focused on the educational benefits derived from using this technology, it should be able to help uncover virtual prototypings great potential as an emerging technology.

A Graphical Tool for the Creation of Terrain Data Files

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This paper describes the Xterr terrain generation system. This system provides a Motif based graphical user interface to the process of specifying and inspecting terrain data. This systems interface was designed to take maximal advantage of the graphical capabilities of modern workstations. The main design criteria for this system was to provide an intuitive interface that allows users with a limited understanding of cartography and the source data to specify and generate high quality terrain files combat simulation systems. To this end, Xterr provides an easy way to specify the location for which the terrain is to be generated, it provides tools to inspect the data, and it also provides a way to modify the elevation data to correct flaws in the data. By putting all of the needed tools into a single package, a uniform interface is provided for all of the terrain data processing functions needed to produce quality terrain files.

Features of the system include a uniform interface where virtually all specification can be done with the mouse pointer, expert system-like help to guide the user through the creation process, a flexible tool to allow the two and three dimensional inspection of the elevation data, a customized data editor that allows for the quick correcting of flawed data, a flexible source data availability database that keeps track of what source data is available, and low computational requirements so that the system does not need to run on high end systems.

Wednesday, 0830-1000
Simulation in Support of Developmental and Operational Testing for the Predator SRAW

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This paper describes MITRE's plan for using modeling and simulation (M&S) in support of concurrent Developmental Training

(DT) and Operational Testing (OT).

While there are many applications of M&S to DT, the unique requirements of OT (independence of the test agency from the acquisition force, and real Marines, in real environments, doing the real things) mark it as fundamentally different from DT. Due to these unique requirements, the use of M&S in support of OT has been limited.

MITRE, in conjunction with the Marine Corps Modeling and Simulation Management Office (MCMSMO), the Marine Corps Systems Command (MARCORSYSCOM), and the Marine Corps Operational Test and Evaluation Agency (MCOTEA), is applying M&S to support the DT/OT of the Predator SRAW. This support is provided via the M&S/Hardware in the Loop (HITL) testbed. The testbed integrates a Predator SRAW Guidance Control Unit (GCU) with various models and simulations.

The testbed M&S components provide stimulation to the HITL. This stimulation models the inputs the GCU would receive prior to an actual firing. A six degree of freedom, physics based flight model simulates the missile flyout, reacting to output from the GCU. In addition, the GCU receives, and acts upon, simulated environmental stimulation (e.g., air temperature, wind velocity). An object oriented simulation environment mimics the functions of the weapon's sensors and the actuation of the warhead. This simulation environment is provided by a process model running in the Force Level Analysis and Mission Effectiveness System (FLAMES).

Advanced Sub-system, Element, and System Simulation (ASESS)

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Approved abstract not available at printing.

<u>Wednesday, 1330 -1500</u>
Displaying Live Entities in DIS Simulations

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Instrumented data from live maneuver exercises at two of the Army's instrumented ranges was converted into Distributed Interactive Simulation (DIS) Protocol Data Units (PDUs) and replayed in the Janus, PEGASUS, VR Link, and NPS Net simulations. The two instrumented ranges which provided data are the National Training Center (NTC), at Fort Irwin, California, and the Mobile TEXCOM Experiment Center (MTEC) at Fort Hunter Liggett, California. TRAC-Monterey developed the software to convert the MTEC data into DIS PDUs as well as the software to replay these PDUs as part of the Distributed Interactive Simulation Technologies in AAR (DISTAR) project. TECOM used VR Link to develop the software to convert the NTC data into DIS PDUs for the Combat STARR project. TRAC-Monterey used the VR Link Data Logger software to broadcast TECOM's DIS PDUs from the NTC onto a computer network and ultimately displayed a replay of the live NTC maneuver forces in the Janus, NPS Net, and VR Link simulations.

This paper discusses the general DIS conversion issues which are applicable to both the NTC and MTEC data, and presents the TRAC-Monterey algorithms and heuristics that were developed to convert the MTEC data into DIS PDUs. This paper also discusses the characteristics of the visual display of the systems that are generate by DIS PDUs when they are displayed in the different simulations.

The Joint Warfare System (JWARS) Software Development Process

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The department of defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

JWARS is a large scale object-oriented software engineering project. The software development process must address a large and complex mission space within a changing doctrinal and technological environment. In order to meet these development objective, the JWARS Office adopted a spiral-based software engineering approach. This presentation, and accompanying paper, describe the software engineering process in detail. Included is an assessment of how this approach meets the complex and diverse development objectives of JWARS.

Preliminary Guideline for Distributed Simulation Analysis and Engineering Applications

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The US Army TRADOC Analysis Center at Monterey has proposed an integrated approach to analysis in advanced distributed simulation (ADS) using the high level architecture (HLA). We claim that this approach fully embraces the HLA standard and enhances analysis capabilities. To develop this approach, we examine the HLA from the point of view an analyst who might use a distributed simulation for a study. We assess in general terms how this analyst might specify data requirements, develop a data collection scheme with resource allocation, and verify that the data will fulfill the study requirements. We also suggest software tools that support this proposal. This paper summarizes that proposal and explains how many of the same tools that support this proposal. This paper summarizes that proposal and explains how many of the same tools developed for analysis in advanced distributed simulations can support analysis in stand-alone simulations. The level of model abstraction provided by the HLA simulation object model (SOM) can serve the analytical community as it strives to satisfy unanticipated demands in complex, uncertain times. Consensus on analysis requirements in Advanced Distributed Simulations will allow the analysis community to exploit the HLA standard by crafting general purpose tools that support a broad range of analytical needs.

Wednesday, 1530 -1700
Facilitating Information Flow in Wargames

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Wargames used to examine future concepts or to conduct training in the strategic art can use information from many sources such as information from other wargames, from real exercises and operations, and from actual sites on the Internet. Typically the information is provided to participants as a thick stack of reading material. Is that the best way to operate in the information age? Several issues should be considered. During wargame development it is necessary to be able to update and edit the information that will be given to the game participants. Displaying the information in an easily accessible and easy to use format with minimal training for the players of the information is also important for organizations in the wargaming business. Finally storing the information for archival purposes and

for future re-use is also important.

An approach used at the US Army War College to accomplish these objectives is to use Intranets to providing information to wargame participants, observers and controllers. The purpose of this presentation is to demonstrate the Intranet used to support the Strategic Crises Exercise at the Army War College in March 1997. Lessons Learned about the creation and use of this Intranet will be discussed as well as recommendations for those interested in pursuing the use of this technology for wargames.

Concept Exploration on the Virtual Battlefield

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This paper reports on the use of virtual simulation for concept evaluation. It focuses on excursions conducted at the Institute for Defense Analysis (IDA) Simulation Center for the 1996 Defense Science Board (DSB) Summer Study on Tactics and Technology for 21st Century Military Superiority . These excursions engaged a slice of a 2015 battlefield portraying only the targeting elements of two small teams (2-3 men each) plus an intermediate headquarters and a task force headquarters. The exercise was divided into trials designed to investigate combat effectiveness resulting from parametric variations in small team size and composition, mission, organic sensor capabilities, and remote sensor suites. The teams interfaced with a synthetic battlefield, visually through 3D visualization portals and electronically through sensor and communications interfaces. Future doctrine was initially developed and incrementally changed from lessons learned during the excursions. The project produced results on the evaluation of battlefield concepts and on the evaluation of advanced distributed simulation's utility for analysis.

Model Building in JWARS

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The Department of Defense uses many analytical modeling tools for the Defense Planning, Programming, and Budget System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System. This presentation will provide a discussion of the philosophy maintained by JWARS in developing a tool for defense analysts to use in the construction of simulation models and how software technologies are being employed in support of this philosophy. Existing model building techniques are frequently cumbersome and time consuming. An overview of the new or previously little used model building techniques being incorporated into JWARS will be provided along with supporting examples from the JWARS prototype.

Thursday, 0830-1000

COMPOSITE GROUP VII SESSION

Thursday, 1330-1500

Massively Parallel Solutions of Large Multi Echelon Inventory Problems

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Multi-echelon inventory models are routinely used by all Services for peacetime and wartime/contingency requirements determination and evaluation. These models support decisions on billions of dollars of repair, procurement, and stocking recommendations, as well as the strategic and tactical missions and capabilities of the US Armed Forces. A speedup in run times of these models will foster the increased sensitivity analysis necessary when making costly inventory and logistics decisions that affect the ability of our weapon systems to support both peacetime and wartime/contingency mission goals.

This presentation will discuss AMSAA work on developing massively parallel solutions for large multi-echelon inventory problems. We will present results employing coarse grain parallelism, fine grain parallelism, and High Performance Fortran auto parallelization techniques on the IBM SP2 at the Maui High Performance Computing Center. Orders of magnitude speedup have been achieved on large "compute bound" problems. We will also discuss the pleasures, frustrations and future outlook of working in today's emerging field of massively parallel computers focusing on the role of massively parallel computers in Decision Support Systems and other Operations Research type problems.

Thursday, 1530-1700

Anti-Armor Advanced Technology Demonstration (A2ATD): Summary of all Experiments

Michael J. McCarthy, Jamaine Burrell, Mark Burrough, Lilly Harrington, Don Hodge, Irene Johnson, Sylvia Nguyen, Joseph Pinto, Mike Schmidt, Floyd Wofford, Tom Ruth, Wilbert Brooks
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The purpose of the Anti-Armor Advanced Technology Demonstration (A2ATD) is to develop and demonstrate a credible (verified and validated) Distributed Interactive Simulation (DIS) capability through a series of six experiments. The first experiment replicated two M1A2 Abrams main battle tank Initial Operational Test (IOT) vignettes to validate virtual simulation with live simulation. Experiments 2, 3, and 5 illustrated the credible use of DIS for anti-armor evaluations in a heavy-force scenario. Experiment 4 demonstrated the linkage of a DIS-compatible version of Janus (JLINK) developed by A2ATD. Experiment 6 illustrated the credible use of DIS for a light-force scenario with Rapid Force Projection Initiative (RFPI) systems. All of the experiments have been completed. This paper summarizes the objectives of A2ATD and the results of the six A2ATD experiments.

MOE Sensitive Management for Multitrajectory Simulation

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MOE Sensitive Management for Multitrajectory Simulation Multitrajectory simulation events in which the event may produce multiple outcomes. New states and their trajectories are generated for each possible outcome, and have associated probabilities that are a proportion of the outcome space. The potential combinatorial explosion of trajectories and states is bounded by trajectory management algorithms that seek to conserve information important to the analyst from among the possible trajectories. In past work, the management strategy has been to conserve the trajectories representing the largest possible proportion of the total outcome space of the simulation. The pitfall is that some particularly important cases may be discarded because they have low probabilities. This paper describes results from using a new management strategy which is sensitive to both probably and a selected Measure of Effectiveness (MOE). The approach was tested using a prototype simulation "eaglet" which was designed to represent the most important features of "Eagle", a Corps scope simulation used for Army analysis. Past results with earlier management algorithms showed that a focus only on probability risked missing interesting outcomes. The new management strategy is sensitive also to loss exchange ratio, and preferentially keeps states having extreme values of this MOE. A series of experiments have indicated that the approach does indeed preserve the extreme cases, sacrificing some of the outcome space coverage, in a manner superior to stochastic simulation and the earlier multitrajectory techniques. Work remains to be done on the issue of how well these techniques perform as the scenario size scales up.

WG32 - ADVANCED ANALYSIS, TECHNOLOGIES AND APPLICATIONS - Agenda

Chair: Dr. Michael R. Anderson, U.S. Army TRAC
Cochair: Ms. Cathy Corley, U.S. Army TRAC
Advisor: LTC David Hutchison, OCSA-PAED
Room: C&SC – CR-147 and CR-107

Room: C&SC – CR-147

<u>*Tuesday, 1030-1200*</u>
Simulating an Intelligently Interactive Adversary
Dr. Lawrence J. Fogel, Natural Selection, Inc.

Weapon Mix and Exploratory Analysis
Mr. Arthur Brooks, Mr. Steve Bankes & Mr. Bart Bennett, The RAND Corporation

<u>*Tuesday 1330-1500*</u>
Analysis Using the High Level Architecture
Major Leroy A. Jackson, US Army TRADOC Analysis Center Research Activity

Integration and Aggregation of Data Within a Hierarchy of Models
Captain Byron B. Tatsumi, Air Force Studies and Analyses Agency

<u>*Wednesday, 0830-1000*</u>
Foreign Integrated Air Defense Systems Intelligence Analysis and Production
Mr. David Panson, National Air Intelligence Center

SongSheet: Using Intelligent Concept Searches to Enhance Communication
Mr. Robert N. Miglin, HyperMedia Corporation

System Comparison Procedures for Automatic Target Recognition Systems
2Lt Anne E. Catlin, Dr. Kenneth W. Bauer, & Dr. Edward F. Mykytka

<u>*Wednesday, 1330-1500*</u>
Hyper-Spectral Imagery (HSI) and the Warfighter - A Challenge for Operations Research
Mr. Timothy J. Eveleigh, Space Warfare Center

Evaluating the Military Utility of Ground-based Acoustic Sensor Networks Through Modeling and Force-on-force Simulation
Mr. John D. Pinder, LCDR Randall G. Bowdish, Ms. Gail Halverson, & Ms. Angela Stich, The RAND Corporation

<u>*Wednesday, 1530-1700*</u>
The Special Operations Forces (SOF) Mission Effectiveness Model (MEM): A Fuzzy Logic Decision Support System
Mr. Anthony Cowden, Sonalysts, Inc.

An Application of Funnel Fuzzy Set Theory to the Joint Close Support End-to-End Assessment (CSEEA)
Dr. Jimi D. Whitten & Mr. Pat Smock, TRADOC Analysis Center

An Efficient Optimization Technique for Image Restoration
John L. Maryak & James C. Spall, Johns Hopkins University Applied Physics Laboratory

<u>*Thursday, 0830-1000*</u>
COMPOSITE GROUP VI I SESSION..Ellis Hall

Room: C&SC – CR-107

<u>*Thursday, 1330-1500*</u>
Hybrid Genetic Algorithm and Neural Networks for Model Consistency
Mr. Clark Dorman & Dr. Robert Sheldon, System Simulation Solutions, Inc.

Neural Network Based Classification of Mobile Targets with Multisensor Data
MAJ William M. Crocoll, Ph.D., U.S. Army Logistics Management College

Modeling Integrated Logistics Support Operations for "Fighter Wing Equivalents" Through Dynamic Simulation
LTC Stephen R. Parker, U.S. Army Concepts Analysis Agency & Mr. Patrick M. Williams, BDM Federal, Inc.

Thursday, 1530-1700
Matching Army Requirements To Yearly Resources (MARTYR)
MAJ Steven M. Aviles & Mr. Barry P. Groves, U.S. Army Concepts Analysis Agency

QMAN - An Approach to Determining Maintenance Manpower
CPT Rick Jenkins & Mr. William Weaver, Armstrong Laboratory

WG32 - ADVANCED ANALYSIS, TECHNOLOGIES AND APPLICATIONS - Abstracts

Tuesday, 1030-1200

Simulating an Intelligently Interactive Adversary

Dr. Lawrence J. Fogel, President
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Effective decision support and training requires realistic simulation of the combat environment including the enemy force, its decision making ability and mission.

Having qualified individuals simulate the OPFOR is dangerous. It presumes we understand their doctrine and culture. Such simulations are non-repeatable and cannot be calibrated. It is equally dangerous to train against rule-based enemy (expert system), for the real enemy is intelligently interactive, learns, may demonstrate initiative, and behave in a generally unpredictable manner.

In contrast, the Valuated State Space Approach coupled with an Evolutionary Program can overcome this difficulty, generating meaningful tactics in view of the assigned mission and developing situation without any instruction regarding tactics. The Valued State Space Approach provides a convenient way to express the enemy's mission in measurable terms. Alternative courses of action can then be scored in view of their projected outcome. The Evolutionary Program uses fast-time iterative mutation and selection to discover increasingly appropriate courses of action in light of that mission until one of sufficient worth is found (or there is no more time for computation).

This has now been demonstrated in real-time tank platoon combat given arbitrary missions and environment. Meaningful tactical decisions are made every 20 seconds through 30 generations. This promises to provide significantly improved decision support and training.

Weapon Mix and Exploratory Analysis

Mr. Arthur Brooks, Mr. Steve Bankes, & Mr. Bart Bennett
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Over the last several years at RAND, a new approach to analysis using modeling and simulation has been developed. This approach, called exploratory analysis, is a methodology designed to enhance understanding of complex problems by providing a wider range of information for decisionmakers than that gotten from traditional analysis. This presentation discusses the advantages of exploratory analysis in the context of a relevant defense problem: selecting the best weapon mix.

Traditional model-based analysis determines outcomes for the most likely conditions surrounding the scenario(s) of interest. Concerns about uncertainties or unknowns in best-estimate input values are examined using traditional sensitivity analysis. A frequently occurring problem here is that sensitivity analysis uncovers instabilities in the results: changing the input conditions causes some output values to change erratically and often in nonintuitive ways. It has often been assumed that resolving these problems requires fixes to the model or improvements in measuring the input data.

Exploratory analysis approaches the model very differently. For the weapon mix problem, we show that these instabilities are

not due to the model or the data, but to how the model has been used. More importantly, exploratory analysis provides greater information that improves decisionmaking flexibility, affords the ability to assess robustness across contingencies and provides a method of risk neutralization in the case of uncertain input values.

Tuesday, 1330-1500

Analysis Using the High Level Architecture

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The US Army TRADOC Analysis Center at Monterey has proposed an integrated approach to analysis in advanced distributed simulation (ADS) using the high level architecture (HLA). We claim that this approach fully embraces the HLA standard and enhances analysis capabilities. To develop this approach, we examine the HLA from the point of view an analyst who might use a distributed simulation for a study. We assess in general terms how this analyst might specify data requirements, develop a data collection scheme with resource allocation, and verify that the data will fulfill the study requirements. We also suggest software tools that support this proposal. The paper summarizes that proposal and explains how many of the same tools developed for analysis in advanced distributed simulations can support analysis in stand-alone simulations. The level of model abstraction provided by the HLA simulation object model (SOM) can serve the analytical community as it strives to satisfy unanticipated demands in complex, uncertain times. Consensus on analysis requirements in Advanced Distributed Simulations will allow the analysis community to exploit the HLA standard by crafting general purpose tools that support a broad range of analytic needs.

Integration and Aggregation of Data Within a Hierarchy of Models

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Prior analytic efforts have often been poorly linked and coordinated across the hierarchy of models. This lack of traceability of how detailed modeling outputs lead to more aggregate models limits the credibility and consistency of these more aggregate tools. Each level of analyses, including campaign, mission, and engagement are all dependent on each other. Engagement and mission level modeling outputs are generally required to "feed" the campaign level input data. Similarly, campaign level results provide a credible "game board" for mission and engagement level analyses. A campaign level snapshot of a scenario at day X can be used as a starting point for engagement or mission level models.

Implementation of the necessary model linkages requires the completion of two critical tasks. The first task is developing a process/methodology for integration and aggregation of model data. This process/methodology is continually modified to meet changing requirements and needs. The other critical task is creating automated tools to manage and store large amounts of model data.

The presentation will introduce the concepts of integrating and aggregating data within a model hierarchy, as is being implemented for the Defense Planning Guidance Baseline; provide an overview of what model linkages are necessary; and then expand the example to include a working model application. Future efforts are planned to expand and complete integration and aggregation of model data.

Wednesday, 0830-1000

Foreign Integrated Air Defense Systems Intelligence Analysis and Production

Mr. David Panson
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This presentation will discuss the new DoD IADS Support Program (DODISP) and how a new team has been formed to pool resources from several organizations to conduct IADS intelligence analysis and production. This approach eliminates redundancy and allows for a single point of contact for foreign 'big picture' IADS intelligence, namely NAIC/GTI. To further help stretch resources NAIC/GTI is pioneering a new virtual production effort to bring the various team members together in a virtual environment to facilitate intelligence production electronically. IADS products are becoming paperless with a push towards total visualization techniques to illustrate the IADS, using point and click techniques to bring up details. Visualization will go hand in hand with modeling and simulation

efforts beginning to take shape in GTI.

Modeling and simulation will play a key role in the analysis of foreign IADS. NAIC hopes to leverage off existing simulation tools with wide community acceptance as well as developing any new tools that are required. Simulations may include integrating existing proven models into the simulation. Eventually, NAIC hopes to have a completely interactive IADS simulation/visualization. The user will be able to play as an interactive participant at any point in the IADS. This could be from a pilots point of view inside the cockpit as he flies into an enemy IADS, to a radar operator on the ground watching his radar scope.

Modeling and simulation techniques will have to be flexible enough so that any type of IADS can be modeled quickly since it will be unrealistic to have an IADS model on the shelf for every country. As new IADS technologies evolve the simulations will also have to be able to adapt in order to provide accurate representations. We also hope to also use our IADS models as customer products that can be combined and used with the customers own models and simulations where threat IADS modeling is required

SongSheet: Using Intelligent Concept Searches to Enhance Communication

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The work reported in this paper began in January 1997. Project SongSheet is an initiative by the Deputy Director, Congressional Actions and Internal reports (CAIR), Office of the Under Secretary of Defense (Acquisition & Technology) (A&T), to improve the Under Secretariat's accuracy, consistency, and timeliness in dealing with Congress. Project objectives include (1) that A&T accurately receives and interprets information from Congress (e.g., bills, laws, reports, etc.); and (2) that A&T accurately and coherently sends information to Congress (e.g., statements, inserts, reports, etc.).

CAIR receives information from many, often disparate, sources and requires detailed, thorough knowledge of its content. Part of CAIR's mission is to interpret and analyze this information. CAIR provides information to Congress and the OSD staff, synthesizes coherent positions, assesses the impact of Department or Congressional actions and/or comments, and prepares the A&T executive leadership for interactive discussions with Congress.

SongSheet is a prototype effort to support this mission. The project applies Thunderstone Software's intelligent concept searching and text retrieval technologies to the A&T/Congress dialog. The system's engine, "Metamorph," pulls concepts and patterns from text and tables and maintains content statistics. It also associates text with graphics files from any origin. The automation of SongSheet provides CAIR with a maximum chance of finding all relevant, conceptually related information to the question or issue at hand. CAIR thereby gains better visibility into the documentation that surrounds their dealings with Congress and the A&T staff, enabling consistency, completeness, and timeliness.

System Comparison Procedures for Automatic Target Recognition Systems

2Lt Anne E. Catlin, Dr. Kenneth W. Bauer, Dr. Edward F. Mykytka
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Estimating the performance of an automatic target recognition (ATR) system in terms of probability of successful target identification involves extensive image collection and processing, which can be very time-consuming and expensive. Therefore, we investigate the Wald sequential test for the difference in two proportions as a sample size-reducing alternative to the ranking and selection procedure and confidence intervals. An analysis of the test parameters leads to a practical methodology for implementing the Wald test for fairly comparing two systems, based on experimental goals. The test is also modified with the multiple sequentially rejective Bonferroni procedure for the multiple pairwise comparison of more than two systems, and two sampling schemes for different experimental goals are discussed.

The test methodology was applied to actual data to compare different configurations of the Moving and Stationary Target Acquisition and Recognition (MSTAR) System with good results. In a two-system comparison with real data, the Wald test required an average of about one sixth as many samples as ranking and selection. To compare four systems with simulated data, the Wald test usually needed only one third as many samples as multiple pairwise confidence intervals to detect specified differences between the proportions, and one half as many samples as required by ranking and selection. These sample size savings demonstrate that the Wald sequential procedure with the modifications described in this thesis is a useful alternative to comparing proportions with confidence intervals, particularly when data is expensive.

Wednesday, 1330-1500

Hyper-Spectral Imagery (HSI) and the Warfighter - A Challenge for Operations Research

Mr. Timothy J. Eveleigh

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Approved abstract not available at printing.

Evaluating the Military Utility of Ground-based Acoustic Sensor Networks Through Modeling and Force-on-force Simulation

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Advanced acoustic sensor networks are capable of detecting, locating, tracking, classifying and, in some cases, identifying military ground vehicles on the battlefield. Such networks may also be able to automatically locate enemy artillery with targeting quality precision. This presentation describes an advanced acoustic sensors model, developed at RAND, which was integrated into JANUS and used for force-on-force military simulation. The model addresses the key aspects of a notional acoustic sensor network: sound source characteristics; sound propagation and attenuation; background noise levels; target detection; sensor performance and resolution; and sensor fusion (including association, triangulation, classification, and graphical representation). The model facilitates an examination of the impact of typical diurnal changes in meteorological conditions on the performance of an acoustic sensor network, within the context of an operational military scenario. In addition, issues associated with implementing the model in a force-on-force simulation are discussed, with observations and conclusions drawn from an initial analysis of the results. Ultimately, this work is intended to demonstrate how networks of advanced acoustic sensors can be employed by a small, robust military force, while also highlighting the environmental limitations of such networks.

Wednesday, 1530-1700
The Special Operations Forces (SOF) Mission Effectiveness Model (MEM): A Fuzzy Logic Decision Support System

Mr. Anthony Cowden, Senior Analyst
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Navy commandos (SEALs) operate in tactically and environmentally harsh conditions. Some of the factors involved in employing SEAL teams include the capability and nature of the target, the nature of the mission, team size requirements, launch platform, transit platform, and weather conditions such as water temperature, sea state, ocean current, darkness, etc. These factors must all be considered in developing new systems to support SEAL team operations, as well as in making key tactical and even strategic decisions concerning SEAL team employment. While it is possible to define the effect of individual decisions on team effectiveness, it is more difficult to determine the overall effect of multiple competing factors. This presentation describes an effort to develop a decision support system (DSS) that utilizes fuzzy logic in assessing the overall effect of multiple competing factors on SEAL team effectiveness. This system was developed to support analysis of theoretical special operations forces (SOF) employment, but could be employed in support of real-world tactical decision-making.

An Application of Funnel Fuzzy Set Theory to the Joint Close Support End-to-End Assessment (CSEEA)

Dr. Jimi D. Whitten & Mr. Pat Smock
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The Early Entry Force Tailoring Tool (EFFORT) was used to apply funnel fuzzy set theory and the principles of goal programming to force development as a part of the CSEEA. EFFORT uses the output of constructive simulation to produce an optimal force package capable of achieving certain requirements in a constrained environment. EFFORT allowed the study agency to consider diverse goals and tradeoffs such as cost, force lethality, and survivability as factors in the force development process. The presentation will include a discussion of the methodology used, a description of EFFORT, a demonstration of funnel fuzzy sets, a summary of the data inputs to EFFORT, and a brief example of the results.

An Efficient Optimization Technique for Image Restoration

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The goal of image restoration is to recover an accurate version of a scene from a degraded image of that scene, where the degradation may be due to noise, blurring, or nonlinearities introduced in the process of recording a digitized copy of the image.

Image restoration techniques seek to calculate the most likely scene, given the degraded image and a model of the degradation process, using various optimization schemes (e.g., least squares or Bayesian maximum a posterior estimation). Because even modest-sized images have a huge number of possible scenes (each pixel has several possible values), the computational burden of most restoration algorithms is formidable. This is true even of approaches that try to exploit local features of the model (e.g., methods using Markov random fields).

We introduce the use of an advanced optimization method, Simultaneous Perturbation Stochastic Approximation (SPSA), for computing the most likely scene. SPSA is a relatively new technique designed to handle large, complex optimization problems such as image restoration. SPSA is easier to implement than standard gradient-based image restoration algorithms, and can be more efficient than iterative sampling techniques. Numerical results comparing the SPSA approach to some standard methods will be discussed.

Thursday, 0830-1000
COMPOSITE GROUP VII SESSION

Thursday, 1330-1500
Hybrid Genetic Algorithm and Neural Networks for Model Consistency

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Campaign air warfare models require many input parameters. Some of these come from higher resolution models, but the process of making the results consistent between the high and low resolution models may be difficult because of differences in modeling assumptions and implementations. In addition, traditional search methods may be difficult to use because of the long run time of campaign models. In this paper, we present a hybrid Genetic Algorithm and Neural Network approach to improve the consistency between models. Specifically, we improve the consistency between the air-to-air combat results between THUNDER and a higher resolution model using the hybrid approach. Genetic algorithms have been used in a variety of non-linear search contexts and have shown great power to find populations of good solutions. However, these contexts have traditionally been in situations where the evaluation of the GA individuals is easy. In large simulations, the evaluation function can take considerable time due to long run time models. In this paper we present the use of a Neural Network to model the evaluation of the individuals; since the evaluation time of the neural network is small compared to THUNDER, the GA/NN total performance as a function of time is greatly improved. In addition, since the NN learns the input/output relationship between the trained variables, it may be possible to use the NN as an interpolator or response surface tool for the variables of interest.

Neural Network Based Classification of Mobile Targets with Multisensor Data

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This presentation reports on the results of a research effort aimed at determining the applicability of artificial neural networks as part of an analysis subsystem for classifying vehicles with data obtained from multiple, unattended ground based sensors. The concept is to utilize artificial neural networks to assist in identifying critical, mobile, enemy targets (e.g., Scud mobile missile launchers) for command level targeting decisions. A neural network methodology was developed and evaluated for performing vehicle classification with multisensor data collected from simulated unattended ground based sensors. A high fidelity computer simulation, called Sensor Evaluation Model, was used to create a battlefield scenario realistically simulating sensor-vehicle interactions consisting of three sensor types and four vehicle types. Data generated from sensor-vehicle interactions were preprocessed and used to train and test three types of

neural networks. Backpropagation, Probabilistic, and Radial Basis Function networks were evaluated to determine differential performance effectiveness under various training conditions. Optimal network designs were experimentally determined for each network type for each training condition. An overall comparative analysis of classification accuracy and computational efficiency was then conducted to evaluate the performance between the network types' optimal network designs for each training condition. Results showed extremely high accuracy and rapid training and test times for all optimal network designs. Results also showed optimal network performance varied as a function of training conditions facilitating specification of the most effective neural network paradigm under certain conditions. The results of this research support the conclusion that artificial neural networks can be applied successfully as part of an analysis subsystem for classifying vehicles with multisensor data obtained from unattended ground based sensors.

Modeling Integrated Logistics Support Operations for "Fighter Wing Equivalents" Through Dynamic Simulation

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A unique approach is developed for analyzing the balance between supply versus demand in evaluating logistics requirements of the armed forces of the United States. With this approach new ways of measuring combat readiness and logistics support are proposed and available to ensure that the armed forces remain ready to fight during the projected defense draw down beyond the year 2000.

The development of this analysis methodology was established as an alternative approach to answer the never ending question of whether or not the Air Force can maintain logistics to support strategies of force as claimed during the recent Deep Attack Weapons Mix Study (DAWMS).

The contribution of this research is a prescribed method for the strategic analyst to develop an influence diagram which can be used to analyze logistics requirements to project and evaluate force capabilities.

Additionally important to this modeling effort is a prescribed method to evaluate the steady-state logistics flow of fuel and ammunition through time. This will allow the analyst to evaluate various resource strategies, constantly evaluating bottlenecks, and inconsistencies with the logistics flow process. This modeling effort serves as a Simulator to model steady-state logistics flow and as an Output Processor to evaluate and verify TACWAR results.

Thursday, 1530-1700
Matching Army Requirements To Yearly Resources (MARTYR)

MAJ Steven M. Aviles & Mr. Barry P. Groves
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Matching Army Requirements To Yearly Resources (MARTYR) is a utility that has automated the process of sourcing nearly simultaneous missions and identifying where and when units are slotted to go to more than one theater. MARTYR allows the analyst to put numerous TPFDDs (Time Phased Force Deployment Data) on a common time line, and then attempt to source each unit request as it appears. When a unit is not available for deployment, i.e. the unit has already been deployed to another theater, MARTYR will attempt to find a substitute unit based on the unit's SRC. If MARTYR cannot find an SRC match then the unit will be placed in an unfilled file. As units become available, i.e. units are redeployed or reserve units are mobilized, MARTYR will attempt to fill units that are in the unfilled file. MARTYR's output can be on a day by day basis or on a scenario basis. The output consists of five separate files; requests sourced by UIC requested (UIC Match), requests sourced by SRC (SRC Match), requests sourced by a substitute unit (Substitute Match), requests not sourced (No Match), and units still available (Available).

The National Military Strategy requires the Army to be prepared to do peacetime missions. As the Army is required to do more and more of these missions, and as they happen more frequently, the Army needs to ensure it has the proper force structure to execute the National Military Strategy. MARTYR allows the user to ensure the Army has the proper force structure by identifying the type of units that are understrengthed to do the required missions, and by identifying types of units that are overstrengthed. The Army is currently using MARTYR in the Dynamic Commitment games which support the Army analysis for the Quadrennial Defense Review.

QMAN - An Approach to Determining Maintenance Manpower

CPT Rick Jenkins & Mr. William Weaver
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The Queuing Manpower Model (QMAN) was developed to quickly and accurately calculate the number of personnel required to perform aircraft/equipment maintenance in support of aircraft sortie generation. Data used by the model is based on historical aircraft equipment failure rates and maintenance workload. QMAN determines the minimum number of personnel in each Occupational Specialty (OS) needed to sustain a specific aircraft sortie generation rate by applying three different manpower determination algorithms: a queuing-theory algorithm, a utilization adjusted workload algorithm, and a minimum crew size algorithm. The actual maintenance manpower requirement in each OS is the largest of these three values. The Turbo Pascal coded implementation of QMAN has been validated against the Air Force standard maintenance model, the Logistics Composite Model (LCOM). In addition to quickly and accurately determining maintenance manpower requirements, another use for QMAN is as a front end estimator of manpower resource inputs for discrete-event Monte Carlo simulations such as LCOM. Using QMAN manpower estimates as input seed values to LCOM can reduce the complex constraining process required to determine minimum manpower requirements by 75%. Additionally, QMAN can provide quick answers to analysis that would otherwise require extensive simulation run times. Examples of such analysis include the impact on manpower requirements of increased maintainer productivity, variable work shifts and flying requirements, and alternative maintenance occupational specialty structures.

WG 33 - MODELING SIMULATION AND WARGAMING - Agenda
Chair: Mr. John R. Winkelman, Lockheed Martin, Government Electronic Systems
Cochair: Mr. Michael W. Garrambone, Veda, Inc.
Cochair: MAJ Leroy A. Jackson, TRAC-MTRY
Cochair: Vickie Turley, Oak Ridge National Lab
Cochair: Stephen Packard, Oak Ridge National Lab
Advisor: Dr. Sam Parry, NPS
Room: SNCOA – CR-2

Room: SNCOA – CR-2

Tuesday, 1030-1200
Real Time Analysis for the Joint Warfighter
LTC Thomas K. Littlefield, USACOM, JTASC

Advanced Sub-system, Element, and System Simulation (ASESS)
Ms. Callie M. Hill, Teledyne Brown Engineering

Tuesday, 1330-1500
Optimal Weapon Mix for the 21st Century Light Infantry Platoon
LTC John A. Marin and CAPT Eric O. Schacht, United States Military Academy

Soldier Station as a Dismounted Infantry Analysis Tool for Complex, Uncertain Times
Mr. David Ohman and Ms. Shirley Pratt, TRADOC Analysis Center

Joint Campaign Modeling and Simulation Today and Tomorrow
Dr. Joseph J. Molitoris, GRC International

Wednesday, 0830-1000
Weapon Mix and Exploratory Analysis
Dr. Arthur Brooks, Messrs. Steve Bankes and Bart Bennett, RAND

Challenges and Lessons Learned: Modeling the Task Force XXI (TF XXI) Advanced Warfighting Experiment (AWE)
MAJ Kenneth Dzierzanowski, TRADOC Analysis Center

Wednesday, 1330-1500
Joint Scenarios for Land, Littoral and Air to Surface Warfare
Ms. Cindy J. Noble, TRADOC Analysis Center

The Joint Warfare System (JWARS) Software Development Process
LTC Terry W. Prosser, OSD (PA&E), JWARS Office

Verification, Validation, and Accreditation of the Joint Tactical Simulation (JTS)
MSgt John A. Fedrigo, HQ Air Force Security Police Agency

Wednesday, 1530-1700
Simulating Nonlinear Conflict Dynamics
Mr. Thad A. Brown, University of Missouri

A Practical Response to Chaos in Combat Simulations
LTC Rob Alexander and MAJ Gary Harless, USA Concepts Analysis Agency

Thursday, 0830-1000
COMPOSITE GROUP VI I SESSION..Ellis Hall

Thursday, 1330-1500

USAF Prime Warrior Wargaming Course
LTC Robert F. Donohue Jr., MAJ Michael J. Loftus, and Mr. Michael W. Garrambone, Air Force Wargaming Institute

Analysis Using the High Level Architecture
MAJ Leroy A. Jackson, TRADOC Analysis Center

Thursday, 1530-1700
Total System Analysis
Mr. Stephen C. Upton, Los Alamos National Laboratory

A Contractors Approach to Developing a Common Simulation Environment
Mr. Scott Swinsick, McDonnell Douglas Helicopter Systems

WG33 - MODELING SIMULATION AND WARGAMING - Abstracts

Tuesday, 1030-1200
Real Time Analysis for the Joint Warfighter

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The roots of operations analysis go back to World War II where analytic results contributed to military successes such as the Air Battle of Britain, the Island Campaign in the Pacific, and the Battle of the North Atlantic.. Today we continue this legacy by providing analytic support to joint planners, primarily during their deliberate planning cycles. There is also a need to provide analytic support during crisis action planning. In fact, as soon as a deliberate plan is pulled off the shelf for execution, the crisis action planning process begins. Planners have to produce a viable plan in an intense and time critical environment. The purpose of this presentation is to demonstrate an approach for providing real time analysis to the joint warfighter. We found that the process is more important than the analytic tool. This process is based upon tearing down the wall that exists between the operator and the analyst. This is done by building credibility with the operator, understanding his requirements, and providing analytic results that fit into his battle rhythm. Typically, results must be turned around within a three to six hour period. Anything slower is often a wasted effort, decisions will be made with or without analytic results.

This presentation doesn't provide all the answers; however, it provides the insights and approaches that have evolved in the Analysis Branch at the United States Atlantic Command during support provided to the Unified Endeavor exercises and an actual contingency.

Advanced Sub-system, Element, and System Simulation (ASESS)

Ms. Callie M. Hill, Principal Engineer
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This presentation will discuss the methodologies developed for the ASESS model and the proof-of-principle task which populated the current model set. ASESS supports a wide variety of analyses which resolve both system analysis and system engineering issues and allows the user to independently control the fidelity at which the various system elements and sub-system components are modeled. In the future, a wide variety of system components will be hypothesized and analyzed using feasibility, cost, and performance filters. This filtering process will utilize various simulations to support system analysis and system engineering studies at varying degrees of fidelity. For various reasons, the simulations sometimes generate inconsistent or even conflicting results. ASESS has been developed to resolve this problem and to provide consistent, timely analysis results.

The ASESS framework utilizes an object oriented, building block structure which is designed to facilitate future growth. Execution is completely defined by the user through database selection of the models to be executed to conduct the analysis task and to simulate each element. The model selections are made through input by selecting a model number from a list of available models. This list can be generated by ASESS as an option and is organized into model types from which a user may make a selection. The model list includes a definition of the required inputs for each model which often includes another model selection and leads to the dynamic, hierarchical simulation structure. At the highest level, the user selects an analysis manager model and provides a list of the unique elements to be included in the analysis. For each element, the user selects an element manager. The element manager then controls the execution of the sub-system models selected to simulate each element type.

Tuesday, 1330-1500

Optimal Weapon Mix for the 21st Century Light Infantry Platoon

LTC John A Marin, U.S. Army, Assistant Professor
CPT Eric O. Schacht, U.S. Army, Associate Professor
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This goal of this research is to determine the optimal allocation of weapons within the 21st Century Light Infantry Platoon. Specifically, this research addresses the impact of two conceptual weapons systems on the infantry platoon, the Objective Individual Combat Weapon (OICW), and the Objective Crew-Served Combat Weapon (OCSW). Specific design issues addressed include: the optimal allocation of the weapon systems, quantifying the increase in lethality, and assessing the effectiveness of the platoon in varied missions (for example, offensive versus defensive roles). Alternative infantry platoon configurations are modeled using the Janus combat simulation in a variety of scenarios. Additionally, this research discusses the design, creation, verification, and validation of a stand-alone simulation written in Visual Basic that models and assesses the suppressive effects of individual and crew-served weapons. Specifically, the model addresses the bursting characteristics and indirect fire capability associated with the OICW. The construction of the scenarios, results from the analysis, and a demonstration of the stand-alone Visual Basic program are presented and discussed.

Soldier Station as a Dismounted Infantry Analysis Tool for Complex, Uncertain Times

Mr. David Ohman, CW4 (Ret), Operations Research / Systems Analyst
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Soldier Station is a DIS networked, man-in-the-loop virtual dismounted infantryman (DI) simulator with underlying constructive model algorithms for movement, detection, engagement, and damage assessment. It is being developed by TRADOC Analysis Center - White Sands Missile Range, New Mexico, to analyze DI issues pertaining to situational awareness, command and control, and tactics techniques and procedures. Soldier Station is unique in its design to integrate virtual and constructive simulations to provide analytical capabilities. It represents a significant reduction in project risk while offering significant advantages over building the simulation from scratch. Recently, it has been used in its first study to evaluate the use of soldier combat identification (CID) technology to reduce direct fire fratricide. New system developments are underway to support a study of land Warrior System components in order to provide risk reduction through early modeling and simulation of the new technology and input to the Cost and Operational Effectiveness Analysis (COEA).

This paper will describe various issues involved in using Soldier Station for the CID analysis including study design, exercise planning, run-time control, and data collection. Advantages and disadvantages to using such a system will be presented along with lessons learned so far.

Joint Campaign Modeling and Simulation Today and Tomorrow

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Joint Campaign Modeling and Simulation Today and Tomorrow. Dr. J. Molitoris, Naval Warfare Director, GRC International, Washington, DC. Computer simulations have been used for over 50 years by many users, including the defense community. In the 1980's, simulation become well-established in the physical science community as an accepted method, along with experimental and theoretical investigations. Computers also became ubiquitous in both education and everyday life in the early 1990's. Today, several initiatives aim to extend the use of simulations across the defense enterprise from engineering to campaign levels. What is the current state of simulation? What problems must be solved to take users from the difficulties inherent in today's legacy models to a potentially better simulation-based future? How can simulation connect with other well-accepted approaches to the evaluation of systems (the use of expert opinion,

analytical calculations, operational testing, etc.)? How might simulation interface with emerging high data rate systems such as the Direct Broadcast Satellite? Answers to these questions are presented based on experience and the application of new technologies such as cheap COTS software, distributed processing, high bandwidth networking, Java, parallel processing, object oriented technology, and visualization.

Wednesday, 0830-1000
Weapon Mix and Exploratory Analysis

Dr. Arthur Brooks, Doctoral Fellow
Mr. Steve Bankes, Senior Computer Scientist
Mr. Bart Bennett, Operations Research Analyst
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Over the last several years at RAND, a new approach to analysis using modeling and simulation has been developed. This approach, called exploratory analysis, is a methodology designed to enhance understanding of complex problems by providing a wider range of information for decision-makers than that often gotten from traditional analysis. This presentation discusses the advantages of exploratory analysis in the context of a relevant defense problem: selecting the best weapon mix.

Traditional model-based analysis determines outcomes for the most likely conditions surrounding the scenario(s) of interest. Concerns about uncertainties or unknowns in best-estimate input values are examined using traditional sensitivity analysis. A frequently occurring problem here is that sensitivity analysis uncovers instabilities in the results: changing the input conditions causes some output to change erratically and often in non-intuitive ways. It has often been assumed that resolving these problems requires fixes to the model or improvements in measuring the input data.

Exploratory analysis approaches the model very differently. For the weapon mix problem, we show that these instabilities are not due to the model or the data, but to how the model has been used. More importantly, exploratory analysis provides greater information that improves decision-making flexibility, affords the ability to assess robustness across contingencies, and provides a method of risk neutralization in the case of uncertain input values.

Challenges and Lessons Learned: Modeling the Task Force XXI (TF XXI) Advanced Warfighting Experiment (AWE)

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This presentation develops the process, models, and lessons learned resulting from the U.S. Army's Training and Doctrine Command (TRADOC) Analysis Center (TRAC), White Sands Missile Range (WSMR) support of the TF XXI AWE. The final part of the TF XXI AWE, March 1997, National Training Center (NTC), Fort Irwin, California evaluated the impact of the force redesign effort and the infusion of advanced information technologies on combat effectiveness.

TF XII is a total redefinition of the Army's fighting forces. How to model a force enabled by Information Age technologies is the challenge. By 2010, the battlefield will be digitized. Digitization will allow commanders and soldiers unprecedented capability to gather and share tactical information. The digitized battlefield involves situation awareness, fratricide avoidance, force synchronization, target acquisition and hand-off, direct and indirect fire support, provisioning, resupply, and recovery.

The goal of TRAC's support of the TF XXI AWE is to provide timely answers to Force XXI issues. TRAC is using multiple means to efficiently model and simulate these complex issues. One method employs the Combined Arms and Support Task Force Evaluation Model (CASTFOREM) high resolution combat model to simulate TF XXI capabilities. The CASTFOREM modeling process is supported by other models such as Janus (a high resolution, stochastic, interactive, constructive model) and various data collection techniques. This method has produced multiple lessons in modeling complex environments coupled with aggressive time schedules.

Wednesday, 1330-1500
Joint Scenarios for Land, Littoral and Air to Surface Warfare

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Uncertain times and decreasing resources are creating more and more joint efforts among the services. These efforts include analytic tools such as JWARS. The Army's TRADOC Analysis Center (TRAC) is starting now in developing robust joint scenarios to support future efforts. TRAC has performed Army analyses in a joint context for numerous years. Recent efforts include the development of robust joint warfare scenarios as they support deep strike and maneuver warfare. These scenarios will incorporate deep strike, interdiction, close air support, SEAD, theater air defense as provided by naval and ground forces, amphibious operations, maneuver warfare, surveillance, reconnaissance, joint communications, support operations and coalition forces in order to analyze our capabilities in defeating threats. These scenarios incorporate smart munitions, theater missile defense attack operations and a detailed review of deployment capabilities. These scenarios provide a tool for analyzing numerous capabilities in a joint context.

The Joint Warfare System (JWARS) Software Development Process

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The department of defense uses many analytical modeling tools for the Defense Planning, Programming, and Budgeting System (PPBS) analysis, Unified and Specified Commander in Chief (CINC) course of action development, and defense establishment force structure and readiness assessments. In the post-Cold War environment, the defense planning context has changed sufficiently that many of the analytical models currently used have become less effective. The Joint Warfare System (JWARS) project is a Deputy Secretary of Defense-directed initiative to develop an analytical model which will meet OSD, Joint Staff, CINC, and service requirements. The goal of the JWARS project is to develop a state-of-the-art object oriented simulation which will fully represent joint operations and portray the effects of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) on combat outcome. The JWARS Office has produced a working prototype and has begun development of a production version of the Joint Warfare System.

JWARS is a large scale object-oriented software engineering project. The software development process must address a large and complex mission space within a changing doctrinal and technological environment. In order to meet these development objectives, the JWARS Office adopted a spiral-based software engineering approach. This presentation, and accompanying paper, describe the software engineering process in detail. Included is a discussion of the management and technical approaches to building the model. Also included is an assessment of how this approach meets the complex and diverse development objectives of JWARS.

Verification, Validation, and Accreditation of the Joint Tactical Simulation (JTS)

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JTS is a high resolution, interactive conflict simulation system developed by the Conflict Simulation Lab at Lawrence Livermore National Laboratory. Primary sponsors of JTS are HQ USAF/SF, USSOCOM, and the US Army. The program is jointly managed for all users by the Joint Warfighting Center. JTS, and an earlier version of the software known as the Security Exercise Evaluation System (SEES), has been undergoing a VV&A process since late 1992. This effort has been sponsored by the Air Force Security Police Agency, now known as the AF Security Forces Center. The primary method used has been comparison of live exercise results with simulation trials. Additional "face validation" and simulation use history information was also considered. HQ Air Force Operational test & Evaluation Center (AFOTEC) convened an accreditation review panel in Feb 97 to complete this process. The results of that panel are captured in this annotated briefing.

Wednesday, 1530-1700
Simulating Nonlinear Conflict Dynamics

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Agent based simulations are used to investigate conflict dynamics. The agents reflect individual entities operating on a complex landscape. The landscape is dynamic, governed by systems similar to Liggett's interactive particle systems. These dynamics are investigated on a lattice in Z**d. Individual agents have local state. The political landscape can be either smooth and rugged. Unlike other simulation efforts, there is not explicit fitness function.

We have dubbed this project The Horde in memory of Ghengis Khan. Our goal is to understand how a large number (200,000) individual agents are organized into competing complex networks. We are interested in observing hierarchical behavior and temporal-spatial dynamics at agent level, the group level, at the environmental level, and so on. We are interested in discerning how to target and to control Horde activity. Within the framework of this simulated system, we wish to know how the elites emerge and evolve based upon the interactions of agents; how elites sustain resources of the group; how they communicate, evolve strategies and ultimately transmit power.

Available resources are modeled uniquely. Some resources exist in the environment; some are stored internally by the agent. Agents get resources through interaction with the environment or with other agents. The rules of interaction can be cooperative and/or conflicting. Horde makes no explicit assumptions of individual agent rationality since each agent is likely to be possessing different levels of information. We also find that behavior often occurs away from a Nash equilibrium for a given situation.

In preliminary simulations, The Horde system has displayed surprisingly complex behavior. We have observed the formation of groups and hierarchies within political resource dependencies. The process by which elites emerge is not uniform. Indeed there are multiple elites required for a complex system to evolve. We observe that elites are often situational, which is emerge suddenly depending on the context confronted by the group or ensemble of agents.

We are also interested in how rules of interaction evolve based on conflict. One of our expectations is that as two competing states develop progressively more complex offensive and defensive strategies, the rules that govern their interaction also evolve. Such rule evolution may reflect the sensitivity of elites to differing levels of renewable resources. Or it may reflect the elites' response to multi-criterion decision-making. The outcome we observe is for various elites to develop idiosyncratic, but contextually dependent, strategies. Such strategies are rarely anticipated. Such strategies appear to govern sophisticated behavior by elite agents.

A Practical Response to Chaos in Combat Simulations

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Simulation is used to study systems whose behavior over time is not capable of being described by closed-form equations. When these systems are dynamical, such as combat operations, they may exhibit chaotic behavior, and any statistics computed from a simulation of the system, itself a dynamical system exhibiting chaos, are meaningless. Even worse, if the dynamical system is complex so that it has no generating partition, the system's long-term behavior cannot be understood at all, statistically or otherwise. Despite such daunting theoretical results, simulation continues to be used extensively to estimate the contribution to force effectiveness of new weapon systems, force structures, and doctrine, to review actual and proposed campaign plans, and for many other important purposes.

While the existence of chaos in combat models is well established, there has been less discussion from the perspective of the practitioner. What are we to do about chaos in our simulations in order to provide appropriate advice to decision-makers? This presentation will address several examples of the chaotic nature of simulations as encountered in real-world usage, and propose a number of practical approaches to reduce the influence of chaos on the output, or at least to gather insights from the simulation of an admittedly chaotic system.

Thursday, 0830-1000
COMPOSITE GROUP VII SESSION

Thursday, 1330-1500
USAF Prime Warrior Wargaming Course

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ABSTRACT: The Prime Warrior Program is a CSAF directed response to prepare Air Force participants for joint wargames, analyses, and exercises. To validate and document this formal training, a Training Systems Requirements Analysis (TSRA) was initiated by AF/XOC, the Air Force Air Education and Training Command, and Air Combat Command. The analysis was conducted by the USAF Wargaming Institute, Maxwell AFB, AL with support from Veda Inc. to determine the knowledge requirements and subject area focus of the wargaming course. This unique presentation summarizes the results of a large scale survey on wargaming exercises and provides a complete description of the course program of instruction. The briefing concentrates on the contents of four educational blocks; two supporting blocks on fundamentals of Operations Research and concepts of Modeling and Simulation, a block devoted to Doctrine and Operations, and the primary block on Wargaming and wargaming models. Presentation attendees will find the briefing to be both enlightening and entertaining since the subject of wargaming carries both a military warfare and purely intellectual stimulating perspective. In addition, this presentation will demonstrate several multimedia educational products which will be used to support instruction.

Analysis Using the High Level Architecture

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The US Army TRADOC Analysis Center at Monterey has proposed an integrated approach to analysis in advanced distributed simulation (ADS) using the high level architecture (HLA). We claim that this approach fully embraces the HLA standard and enhances analysis capabilities. To develop this approach, we examine the HLA from the point of view an analyst who might use a distributed simulation for a study. We assess in general terms how this analyst might specify data requirements, develop a data collection scheme with resource allocation, and verify that the data will fulfill the study requirements. We also suggest software tools that support this proposal. This paper summarizes that proposal and explains how many of the same tools developed for analysis in advanced distributed simulations can support analysis in stand-alone simulations. The level of model abstraction provided by the HLA simulation object model (SOM) can serve the analytical community as it strives to satisfy unanticipated demands in complex, uncertain times. Consensus on analysis requirements in Advanced Distributed Simulations will allow the analysis community to exploit the HLA standard by crafting general purpose tools that support a broad range of analytic needs.

Thursday, 1530-1700
Total System Analysis

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Given the current, and foreseeable, trend of increasing complexity in the definition, design, development and modification of weapon systems, the complexity of their relationship to other systems, e.g., the system of systems concept, and the declining defense budget, we assert the need for new analysis tools to efficiently address these rising trends of complexity. We define Total System Analysis (TSA) as the complete, seamless and integrated modeling, simulation and analysis environment to support decisions during the development of a weapon system; vertically, from the phenomenological level to the campaign level; and horizontally, from the requirements milestone to the production milestone. The objective of TSA is to provide seamless analyses which addresses the uncertainties, gaps, inconsistencies,

unresponsiveness, and different perspectives of the communities providing input to the acquisition decision environment. This brief will present the past, present, and future prospects of TSA as we are experiencing them.

A Contractors Approach to Developing a Common Simulation Environment

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Approved abstract not available at printing.

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65TH MORSS

10-11-12 June 1997

Marine Corps Combat Development Command
Quantico, Virginia

Schedule for the 65th MORSS

Tuesday, 10 June 1997

0700	0830	Registration
0715	0815	Working Group Chairs/CoChairs Warm-Up
0830	1000	PLENARY SESSION
1030	1200	First Working Group Session (#1)
1200	1330	Tutorials
1330	1500	Second Working Group Session (#2)
1530	1700	SPECIAL SESSION I
1715	1900	Mixer

Wednesday, 11 June 1997

0700	0800	Town Hall Meeting (WG/CG Chairs)
0830	1000	Third Working Group Session (#3)
1030	1200	SPECIAL SESSION II
1200	1330	Poster Session
1330	1500	Fourth Working Group Session (#4)
1530	1700	Fifth Working Group Session (#5)
1700	2030	Picnic and Parade

Thursday, 12 June 1997

0830	1000	Sixth Working Group Session (#6)
1030	1200	SPECIAL SESSION III
1200	1330	Tutorials
1330	1500	Seventh Working Group Session (#7)
1500	1530	Working Group Chairs/CoChairs Wrap-Up
1530	1700	Eighth Working Group Session (#8)